

Unit 3: Recognize the Risks and Mitigation Measures

Notes

Recognize Specific Risks

Recommended Total Time: 3-4 hours

60 minutes for each hazard which includes 15 minutes for its Application Exercise

In this unit you will identify the specific risks for an individual homeowner and then consider which mitigation measures will be most beneficial. We'll discuss the Fact Sheets for the natural hazards; then you will see pictures of a home that has some mitigation opportunities for you to identify.

Use the Action Checklist

Use the Action Checklist after this page to assist you in this exercise and as a job aid in the field. It lists all four hazards and the mitigation measures by number. Those numbers correspond to the ones on the Fact Sheets.

Discuss Fact Sheets for Selected Hazards:

Discuss each Fact Sheet, which includes a discussion of the potential damage that can result from the risk and depicts the risk and the mitigation measure.

Flood
Wind
Earthquake
Fire

Guide a discussion of various pertinent points, such as:

- The relative benefits of these measures for various kinds of properties, including single family and manufactured homes
- Whether the measure is
 - Critical to protecting life, health and safety of people, ensuring the building integrity of the home, or
 - A desirable, but not essential change

Discuss the Fact Sheets for A Hazard

Refer to the following Fact Sheets, one at a time, for each hazard you wish to consider.

Verify Understanding

After discussing the mitigation measures for the hazard:

Ask for questions

- Do the Exercise at the end of the section for that hazard.

Unit 3: Recognize the Risks and Mitigation Measures

Action Checklists – Color and Black & White

(See next 2 pages)

Action Checklist

Name _____

Job # _____

Address _____

Date _____

Inspector _____

100.

- 101. Retrofit your well to reduce contamination ☐
- 102. Maintain storm drains on your property ☐
- 103. Install a gas safety cut-off valve ☐
- 104. Anchor and elevate fuel tanks & AC units ☐
- 105. Anchor your home ☐



FLOOD

- 106. Apply protective sealant to your walls ☐
- 107. Install a septic backflow preventer ☐
- 108. Consider wetproofing options ☐
- 109. Install interior or exterior flood walls ☐
- 110. Relocate or elevate internal appliances ☐

200.

- 201. Reduce potential for flying debris ☐
- 202. Anchor the base of your manufactured home ☐
- 203. Bolt your house sill plate connection ☐
- 204. Increase your gable end bracing ☐
- 205. Replace gable vent with slotted vent ☐



WIND

- 206. Fasten your roof & walls - hurricane straps ☐
- 207. Improve the securing of your roof sheathing ☐
- 208. Improve closure of your windows and doors ☐
- 209. Create a safe area in your home ☐
- 210. Improve the bracing of your "A" frame roof ☐

300.

- 301. Install a gas safety cut-off valve ☐
- 302. Brace your manufactured home ☐
- 303. Bolt your house sill plate connection ☐
- 304. Brace your cripple walls ☐
- 305. Brace your masonry chimney ☐



EARTHQUAKE

- 306. Use flexible connections for gas and water ☐
- 307. Strap your water heater ☐
- 308. Secure your light home contents ☐
- 309. Secure your furniture ☐
- 310. Improve the securing of your wall sheathing ☐

400.

- 401. Create a firebreak around your property ☐
- 402. Relocate or protect your exterior fuel tanks ☐
- 403. Maintain your gutters & clear roof of debris ☐
- 404. Cover openings with fine mesh ☐
- 405. Use fire resistant materials on your home ☐



FIRE

- 406. Install outside spigots ☐
- 407. Install smoke & carbon monoxide detectors ☐
- 408. Provide fire extinguishers in your home ☐
- 409. Install a spark arrester on your chimney ☐
- 410. Keep your chimney clean ☐

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Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Measure Fact Sheets – Flood

(See following 10 pages)



Flood - 101

Retrofit your well to reduce contamination

Flooding is the most frequently occurring disaster in the United States. Most damage comes from river or ocean flooding, but it can also result from the flooding of small streams or creeks that rise quickly.

Flooding normally occurs in the same places. This predictability means you can focus on reducing damage there. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using mitigation opportunities. Now is the best time to floodproof your home and buy insurance under the National Flood Insurance Program.



Potential Hazard



Floodwater can rise so high that it could flow back into your well through the top, where you usually remove your water. Floodwater can be very dirty after it picks up dirt and silt. It can also be contaminated from oil and other very harmful pollutants from garages, houses, cars, farms and factories. These pollutants make the well water unsafe to drink. The cost of purifying the contaminated water or finding another source of safe drinking water may be very high. Also, if the well collar is poorly installed, floating debris will have a greater chance of damaging the well. The photo to the left shows an example of an unprotected well underneath a home. Many wells today have protective collars; even with a collar, your well may not be safe. The gaskets could be cracked from dry rot or old age.

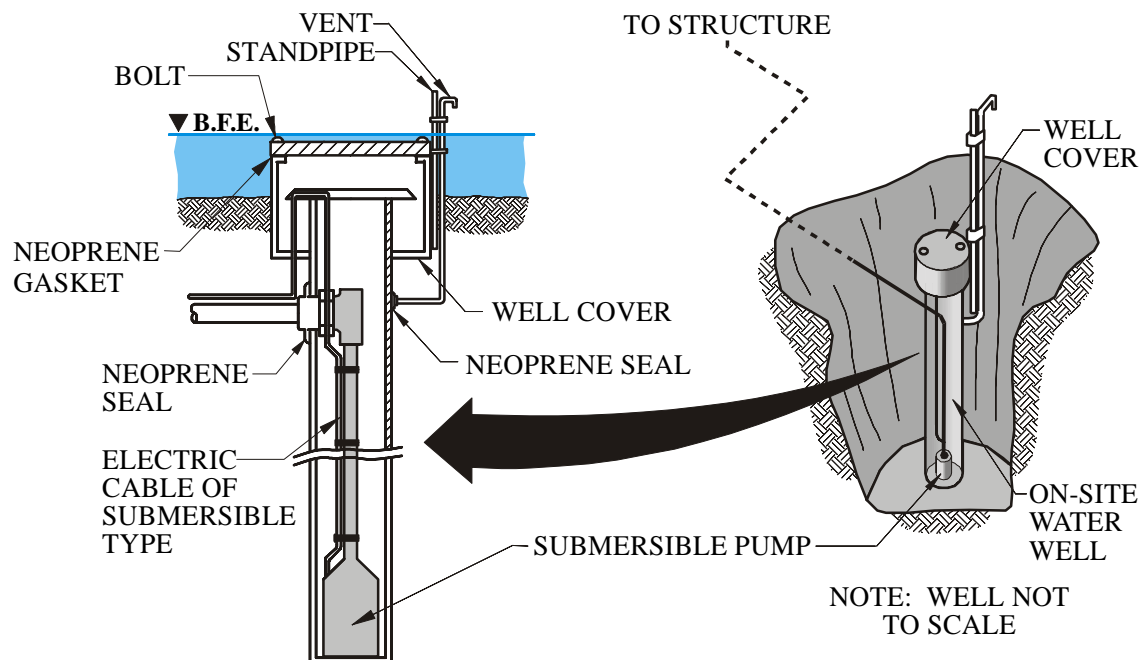
Mitigation Measure

To reduce the risks of floodwaters leaking into your well and contaminating its source, you can raise the protective collar around the well vault. The collar should be raised to 12" above the Base Flood Elevation. If this is impractical, you will have to rely upon a casing with a lid that has a gasket and bolts. A collar that you have to raise more than two and one half feet above ground level is impractical because it is too difficult to do any maintenance. If the floodwater velocity is low, there should be little chance of floating debris damaging the well casing. A properly installed casing with lid gaskets should keep any floodwater from getting in. See the photo of a gasketed well lid.



If the well lacks a protective collar, one should be installed. To do so, first dig around the well to a depth one-foot less than the collar length. For example, for a collar three feet in length, dig down two feet; then the collar's lid will stick up one-foot. Pour grout into the hole to a depth of about four inches. Push the collar into and through the grout so that the bottom of the collar is in soil. Fill the area around the outside of the collar with grout to ground level and let the grout harden. Make sure that the power supply chord and water piping coming out of the collar are gasketed at the interface with the collar – this will keep water from seeping into the collar. A certified plumber or well installer should be hired to do the work. The sketches shown here graphically depict the sort of assembly that should be sufficient to keep floodwaters from inundating your well.

If the well does have a collar, check whether the gaskets are cracked. This checking will require removing the lid cover. If the lid cover gasket needs replacing, you should also replace the other gaskets, too – if they are not cracked, they probably will be soon. A plumber or well installer should also complete this work.





Flood - 102

Maintain storm drains on your property

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Potential Hazard

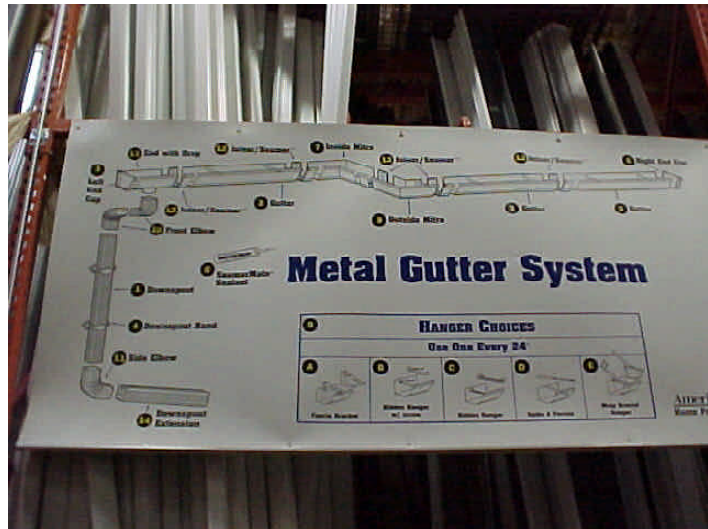
Most roads, paths and properties are sloped so flood and rainwater go to storm drains that collect and carry it away. If the water's path is blocked or the storm drain gets clogged, the water will take a long time to drain or may not be able to drain at all. Then the water collects until it gets high enough to flow another way. This new path could lead right into your home.



Water ponding against the side of your house could also damage its foundation. Saturation of the soil could cause the foundation to settle, and thereby weaken the structure above it.

Mitigation Measure

To reduce your chances of water damage to your home, you need to maintain the guttering, storm drains and flow paths on your property. During a severe rainstorm, leaves and other debris in your gutters may block rainwater from flowing away safely. You should remove debris as needed and leaves after the trees are bare so the water can move away from your home. Also, keeping the guttering downspouts and splash blocks in good condition will help to move unwanted water away from your home.



Gutter guard, a wire mesh with reinforced edges, can be placed over the guttering to keep out leaves that can cause blockages in the downspouts.



After the water has moved through the guttering to the ground, it must go across your property to the storm drains. Therefore, you need to keep the grading from your home and towards the drains clear. For example, you should remove or relocate large raised or built-up flowerbeds, piles of leaves and other garden materials that block or slow the flow of water



away from your home. Also, be sure to clear debris from drainage ditches or gullies regularly so they can carry the water to the storm drain. If there is an area where water ponds against the side of your home, that location may be a good place to plant flowers or shrubs and raise the earth to create drainage away from your home. You may be able to obtain fill dirt from other places on your property, your local government, or a landscaping company.



Flood - 103

Install a gas safety cut-off valve

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Potential Hazard

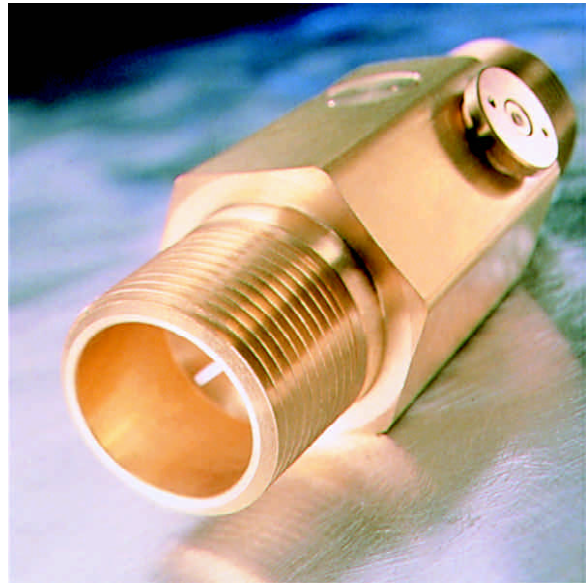


Floodwater often damage gas pipes. Gas pipes can be damaged from even minor floods when they crack or split, or when your appliances shake or are knocked over because your home shifts. Then natural or propane gas may escape into your house and create a serious threat of fire or an explosion. Injuries to you, your family, your home, your neighbors, and the environment may result.

Mitigation Measure

If you are replacing a portable kerosene heater or putting in bottled or tank based propane or natural gas heating systems, then a gas safety cut-off valve is an appropriate and good low-cost mitigation measure for reducing the risks of a gas leak into your home. One such device is

the Sanders Safety Cut-Off Valve, which is installed on your gas pipe outside the home. The Sanders Valve has been approved by the American Gas Association. This self-contained, one-inch valve fits on the low-pressure side of the regulator leading to a gas pipe. Its spring stops the flow of gas whenever there is a break in the pipe or a drop in gas pressure, which may happen when there is an accident or natural disaster. Because the valve is placed in-line above ground, it is easy to determine if a home already has one installed. One needs only to find the gas meter or propane tank and see if the valve is in line near to the meter or the tank.



Installing the valve has many benefits to you. It shuts off the gas flow at the first sign of a gas pipe break or pressure drop, and the valve remains closed until inspection and repairs have been completed. Thus it removes the danger of gas escaping into your home and causing a fire or explosion. The valve does not require any special attention from you because it automatically resets after repairs have been made. Also, it is weather resistant and does not require any power to operate, so it is very cost-effective. Because it is adaptable to a wide range of situations, it can be installed without any digging on your property.



Besides providing protection during a flood, the cut-off valve also provides protection for pipes that could be damaged during an earthquake.

To assemble, install, or service the Sanders Safety Cut-Off Valve, a state-certified plumbing and heating technician or gas utility technician will be required. It should be noted that the valve will work for high or low pressure systems and is easily set.



Flood - 104

Anchor and elevate fuel tanks & AC units

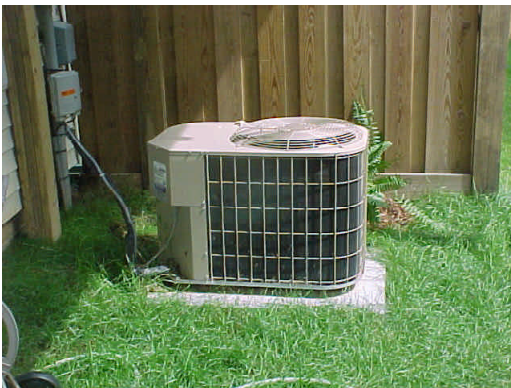
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Potential Hazard

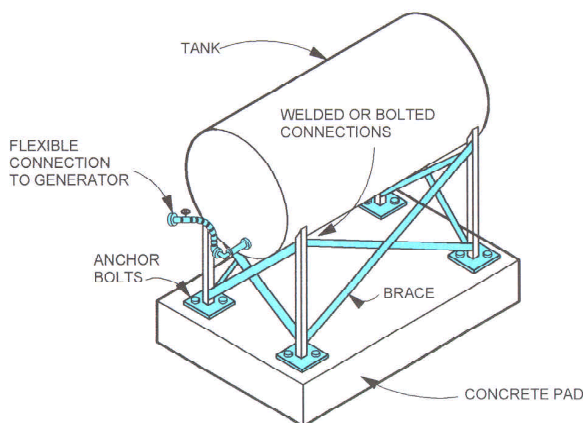
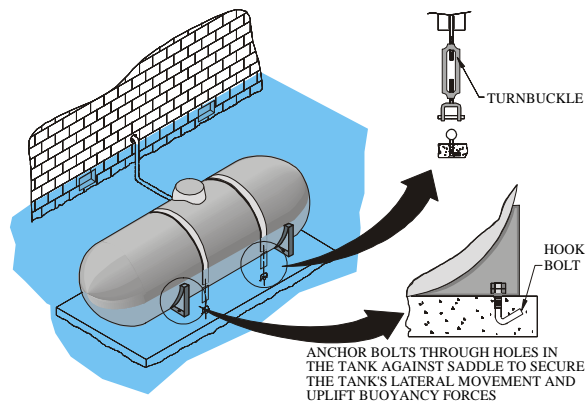
Floodwaters can easily move unanchored fuel tanks, which then may tip over or float. Escaping fuel may result in spills and fires. These tanks pose serious threats not only to you, your family, and your house, but also to public safety and the environment.



An unanchored tank outside your house can smash into your walls and be swept downstream, where it can damage other houses. Even a buried tank can be pushed to the surface by the buoyant effect of soil saturated by water. When floodwaters move an unanchored tank in your basement, the supply line can tear free, and contaminate your basement with oil.

Mitigation Measure

There are several ways to anchor your fuel tank. A method that can be used for any tank, whether it is inside or outside your house, is to attach it to a large concrete slab whose weight is great enough to resist the buoyant and lateral forces of floodwaters. You can anchor an outside tank by running straps over it and attaching them to ground anchors. Use fasteners made of non-corrosive metal like stainless steel or galvanized metal. The structural supports can also be of non-corrosive metal or pressure treated wood. You should also elevate the vent tube above the base elevation. The type of anchorage needed depends on the tank's size and size and stability of the structure it is being attached to.



Whether your tank is indoors or outdoors, keeping it topped off will increase its weight and thereby reduce its tendency to float. If you have adequate warning of a hurricane or other major rain event, ask your fuel company to top off your fuel tank. If your home lies in a flood-prone area and your tank is in the basement, it is especially important to top it off.

To protect an air conditioning compressor or heat pump, elevate it and its service lines to at least a 12" safety margin above the base flood elevation (BFE), including all filling and ventilation tubes. Use a base of masonry, concrete, or pressure treated lumber. If your air conditioner or heat pump is outside, install it securely on a platform above your flood protection level.



Flood - 105

Anchor your home

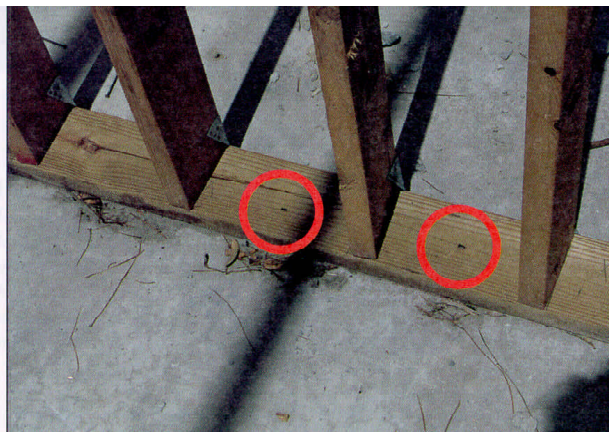
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Potential Hazard

If your home is not adequately anchored to its foundation, it may float away in high floodwaters. Your home may also be pushed from its foundation by the pressure of floodwaters against a sidewall. Houses with wood framing and lightweight covering materials that float are at great risk.



Manufactured homes have additional hazards. They are often anchored to the ground with large pins, called ground anchors. They pull out of water-soaked ground far more easily than from dry ground. A floating or moving home also becomes a hazard that can cause great damage to other structures.

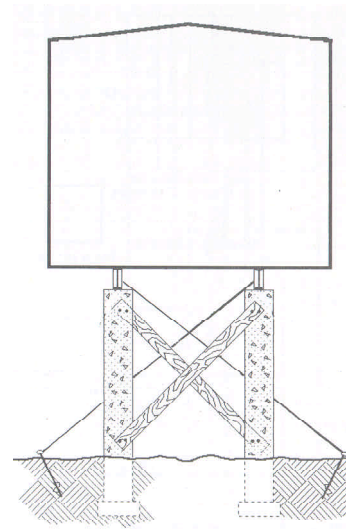
Mitigation Measure

The best protection from these problems is to secure your house to the ground or to a heavy concrete foundation.

A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts spaced at four feet or less and in sufficient embedment.



Manufactured homes can be secured in several ways. To determine your best securing strategy, you must have site-specific flood information. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type are determined by your type of soil. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately, considering the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability.

A manufactured home that is elevated on fill material, such as soil, and is on flat land where expected floodwater speeds are low may not require additional securing.





Flood - 106

Apply protective sealant to your walls

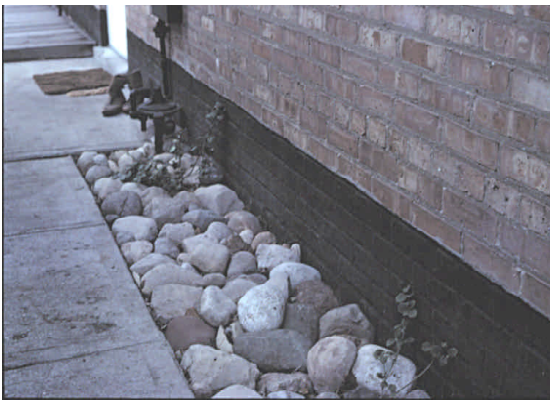
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Potential Hazard

Many homes are flooded by shallow floodwaters. Floodwater even less than two feet deep can severely damage your home if it comes inside. Repairing damage to your walls and floors can be expensive, and you may not be able to live in your home while the work is being done.

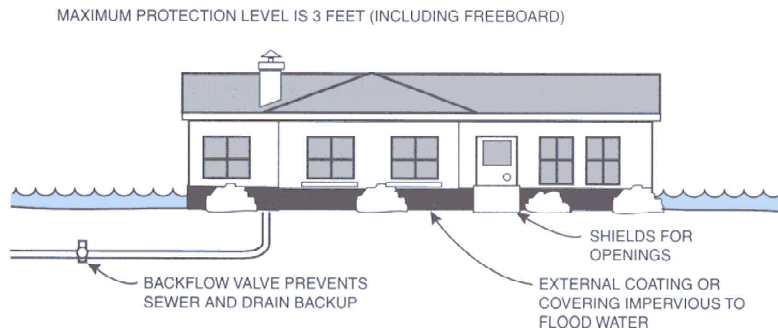


Mitigation Measure

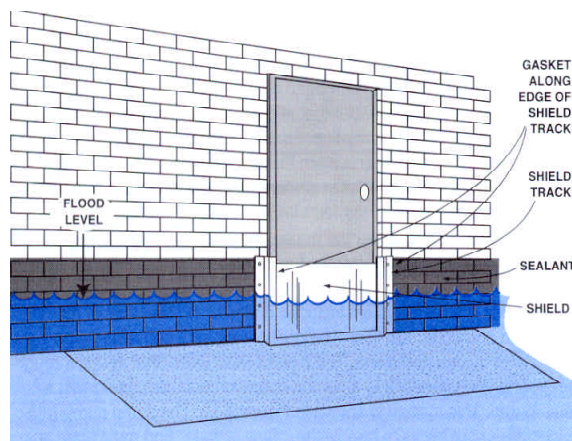
For many homes, it is not economically feasible to raise the entire home one-foot above the Base Flood Elevation (BFE).

Therefore, you need to waterproof your home. One way to do so is to put protective sealants on your walls. To protect your house from shallow flooding, put a waterproof veneer on its exterior walls and seal all openings, including doorways. This method should be used only for

homes that have flood depths less than three feet and should not be used on manufactured homes. The sealant application should not extend higher than one foot above BFE. This limitation is important because typical masonry or frame walls usually require additional bracing or strengthening if they have more than three feet of pressure from still water.



A sealant mitigation measure can be a veneer or layer of brick backed by waterproof sheeting. Before applying the veneer, remove the siding and replace it with exterior grade plywood sheathing. If necessary, extend the existing foundation footing to support the brick. Also, because the veneer will be exposed to floodwater, you might need to make changes to the interior walls so they will resist moisture damage if water gets through the protective coating. In the area below the flood level, replace standard batt insulation with washable closed-cell foam insulation. Use exterior grade lumber for any wood blocking added inside the wall cavity.



All openings, both windows and doorways, need to be flood-proofed, too. You can waterproof doorways and low windows with a removable shield made of either metal or wood. Install a special gasketed sill in the bottom of doorways to ensure a waterproof seal. Bolt the door shield to the frame of the doorway against a gasketed mounting strip. Similarly, mount the window shield against a gasketed window-mounting strip to a height of one foot above the BFE.

Notes:



Flood - 107

Install a septic backflow preventer

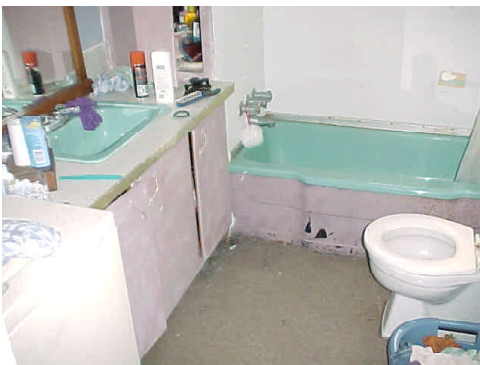
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Potential Hazard

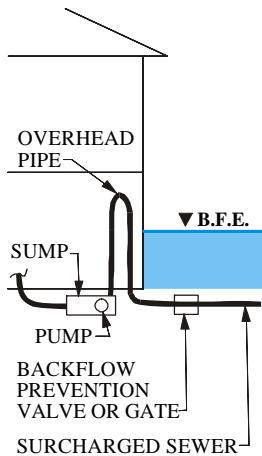
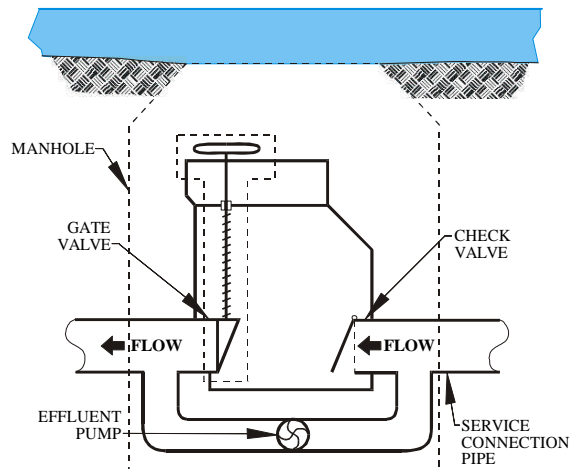
When people think of their home flooding, they usually picture floodwaters coming through windows, doorways, and leaky walls. Another way floodwater can enter the home is through gravity drains, such as septic lines and sump drains. A back up of sanitary sewer lines, which brings sewage into your home, creates an unhealthy situation. Repairing the damage may be expensive, and you may not be able to live there until repairs are made.



Mitigation Measure

A good way to protect your home from sewage backups is to install backflow valves, which are

designed to block drainpipes temporarily and prevent flow into your home. Valves should be installed on all pipes that leave the home or are connected to equipment that is below the potential flood level. Therefore, valves may be needed on washing machine drain lines, laundry sinks, fuel oil lines, and sump pumps, as well as sewer/septic connections. Sump pumps are included because they may be connected to an underground drain line and, as a result, may require excavation before installing a valve.



Backflow valves are available in a variety of designs that range from the simple to the complex. The figure shows a gate valve, one of the more complex designs. It provides a strong seal, but must be operated by hand; therefore, its effectiveness depends on how much advance warning you have of the flooding. Among the simpler valves are flap or check valves, which open to allow flow out of the home but close when the flow reverses. These valves operate automatically but do not provide as strong a seal as a gate valve. Sump drains can be protected in a similar fashion. Some valves incorporate the advantages of both flap and gate valves into a single design.

If you are connected to a municipal sewer system you may consider installing a backflow valve. There have been instances where the municipal sewer system has been surcharged causing flooding in homes that are above the base flood elevation.

Changes to the plumbing in your home should be done by a licensed plumber or contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.

Notes:



Flood - 108

Consider wetproofing options

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Potential Hazards

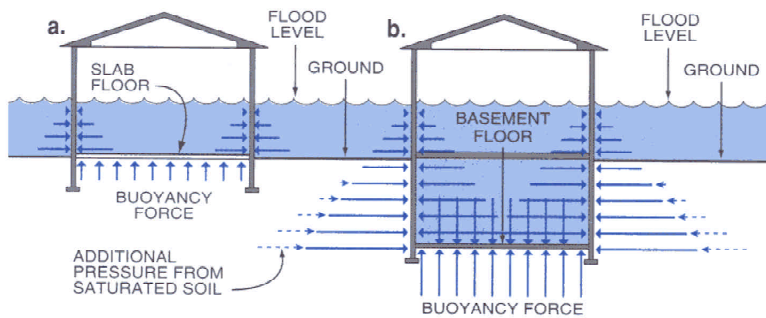
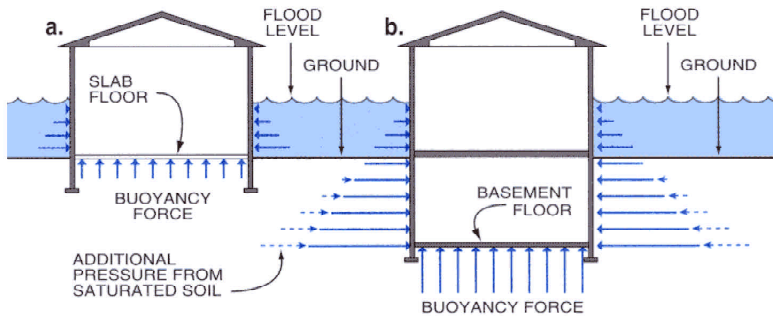
There is a danger to homes if floodwaters are kept out during extended periods of severe flooding. If the walls are not strong enough to resist the pressure, the water could collapse them and destroy the home. This risk is especially strong if the floodwater regularly rises three feet or more. Another potential risk is that if the home is too watertight, it will become buoyant, pull away from the ground anchors or foundation, and float away.



A secondary hazard is that the floodwaters continuously deposit debris and potentially contaminated silt and mud which create health risks. The presence of the silt and mud makes cleanup more difficult and causes moisture to persist. The moisture can create further damage to your home after the floodwaters have receded because mold and mildew thrive in a damp environment. As a result, you may not be able to live in your home for a long time and could have to replace materials that are not water-damaged.

Mitigation Measure

Wet floodproofing is the term for measures taken to protect one's home from these hazards. Wet floodproofing allows the house to flood and avoid structural damage. It uses flood resistant materials and the relocation of appliances and equipment to minimize damage and speed recovery. One measure you can take is to ensure that there is adequate venting so that water moves freely under your home. The venting also helps the crawlspace dry after the floodwater has receded. Any bracing added to the walls should not block these openings.



To protect against damage from long-term standing water inside your home, you can install a floating drain plug in the lowest floor of your home. This solution is most appropriate for manufactured homes. However, any home with a crawl space underneath could

benefit from having floating plugs in the lowest floor. If you let water into your home, the pressures are equalized inside and out so your home does not become buoyant.

As floodwaters recede, the floating drain plug allows water to escape. As the water drains out through the plug, much of the silt and mud may also exit. Your home will still be very dirty; however, with the plug strategically located and easily accessible, your cleanup should be easier.

Another measure is to utilize flood resistant materials below the base flood elevation. These materials will resist damage due to flooding and will not need to be replaced when the flooding recedes. In conjunction with flood resistant materials you should consider relocating appliances and utilities above the base flood elevation.

See FEMA 312 "Homeowners Guide to Retrofitting" and <http://www.fema.gov/mit/rfit>.



Flood - 109

Install interior or exterior flood walls

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Flooding normally occurs in the same places. This predictability means you can focus on reducing damage there. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using mitigation opportunities. Now is the best time to floodproof your home and buy insurance under the National Flood Insurance Program.



Potential Hazard

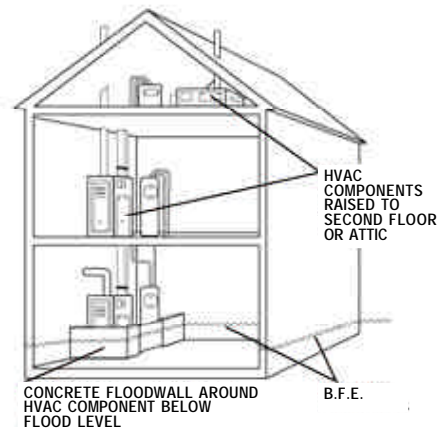
Nuisance or marginal flooding one to two feet deep affects some areas, usually those near the edge of the floodplain. In these areas, anything in the basement, particularly electric appliances, is at risk from water damage. Appliances that are in water for even short periods will probably have to be replaced. Another serious problem is the risk of fires caused by short circuits in flooded systems. Also, cleaning up and making repairs without having electricity are even more difficult.



Mitigation Measure

Flood barriers can protect your property. They work best where flooding is less than three feet deep. First, decide whether to have the flood barriers on the outside of your home or around critical appliances inside your home.

An interior floodwall can protect your home against low levels of flooding. It must be constructed of either concrete blocks or poured concrete and reinforced with steel rods to resist the pressure of the floodwaters. Anchor the new wall into the existing basement wall and floor so floodwaters will not move it. It should be built to one foot higher than the Base Flood Elevation (BFE) but no higher than three feet (for strength reasons). To protect against seepage through the floodwall or basement wall, install a sump pump with a floating switch. The pump's outflow hose should drain the water over the edge of the floodwall. An alternative to an interior floodwall is to relocate utilities to a upper floor above the base flood elevation.

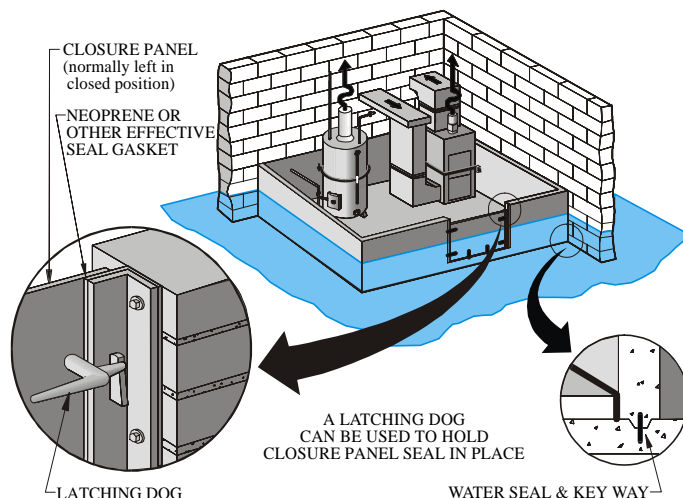


Exterior floodwalls, prevent floodwaters from reaching your home. Floodwalls, usually built of concrete, must be at least one foot above the BFE. Outside berms are small levees, usually built from fill dirt, around window wells or other openings through which flood waters may enter the structure. For best protection, do not install gates that open into the enclosure. It is important to properly evaluate the likely flood conditions and your soil conditions.

Floodwalls, berms, and levees can either surround the building (ring levee) or connect to high ground. They can also be built up against a building's foundation walls. Pumping out water that seeps under the walls will require a sump pump. Similarly, an exterior floodwall constructed of masonry or properly reinforced poured concrete can protect a window well or stairway against low-level flash flooding. In this case, only individual portals are protected because prolonged flooding is not expected. Walls should be supported by and securely tied to a

footing so that they will not be undercut by scouring. Once again, the wall should not be higher than three feet.

See FEMA Publication 348, *Protecting Building Utilities From Flood Damage*.





Flood - 110

Relocate or elevate internal appliances

Flooding is the most frequently occurring disaster in the United States. Most damage comes from river or ocean flooding, but it can also result from the flooding of small streams or creeks that rise quickly.

Flooding normally occurs in the same places. This predictability means you can focus on reducing damage there. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using mitigation opportunities. Now is the best time to floodproof your home and buy insurance under the National Flood Insurance Program.



Potential Hazard

Nuisance or marginal flooding affects some areas of the country, usually those at the edge of the base flood elevation (BFE). If the area has floods of no more than one or two feet, it



may not be cost effective to raise your home to avoid future floods. Anything in your basement is at risk to water damage, especially an appliance that depends on electricity. If it is in water for even a short time, it will probably have to be replaced. Another serious problem is the potential for fires caused by short circuits in flooded electrical systems. In addition, after a flood, cleaning up and making repairs without having electricity are made more difficult.

Mitigation Measure

If only your basement floods regularly, it is easier to relocate or elevate appliances and critical utilities than to raise your home. Typical basement appliances and utilities include clothes washers and dryers, hot water heaters, furnaces, and electric fuse boxes. If your basement has baseboard heaters, those heating units also need to be elevated.

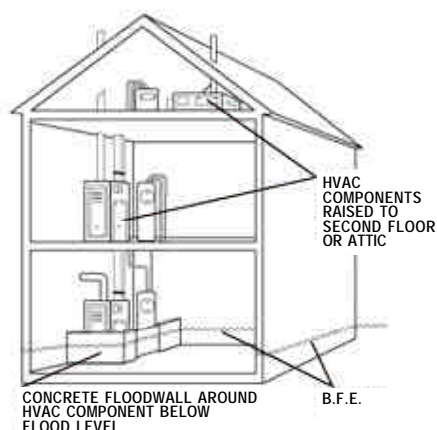
Appliances and utilities can be easily elevated a short distance. Remember to elevate them to at least a one-foot safety margin above the highest known flood level or the Base Flood Elevation (BFE). For low heights, use concrete blocks or a platform made from pressure treated lumber and supported by concrete blocks. Make certain that washers and dryers are secure and will not vibrate off the blocks or platform during use—securely fasten them with straps to the wall or floor. If you have flooding greater than two or three feet, putting these items on the next higher floor may be the best solution since there is limited headspace in the basement.



The best way to protect your valuable electrical system is to keep it from getting wet. All components of the electrical system, including the wiring, should be raised at least one foot above the BFE. Electrical work of this sort may require removing some interior wall sheathing (drywall, for example). It is a good idea to run the wires overhead. If a wire has to run into the areas where it could get wet, use a wire rated for underground use. No wire should end in the flood zone, and all junctions should be located in approved junction boxes.

In homes at high flood risk, protect the heating, ventilating, and cooling equipment by moving it from the basement or lower level of the home to an upper floor or attic. A water heater can

be put anywhere near a hot water pipe. If the existing ductwork for your furnace is below the BFE (e.g., on a slab or in a crawlspace beneath the home), relocate it so it distributes heat from above and runs free and clear of floodwaters. You can replace an updraft furnace in the basement with a downdraft furnace on a floor above the flood protection level .



See FEM A Publication 348, *Protecting Building Utilities From Flood Damage*.

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Flood Exercise Sheet
Assess Flood Risks	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Flood Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	
9	

Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

Flood Risk Pictures

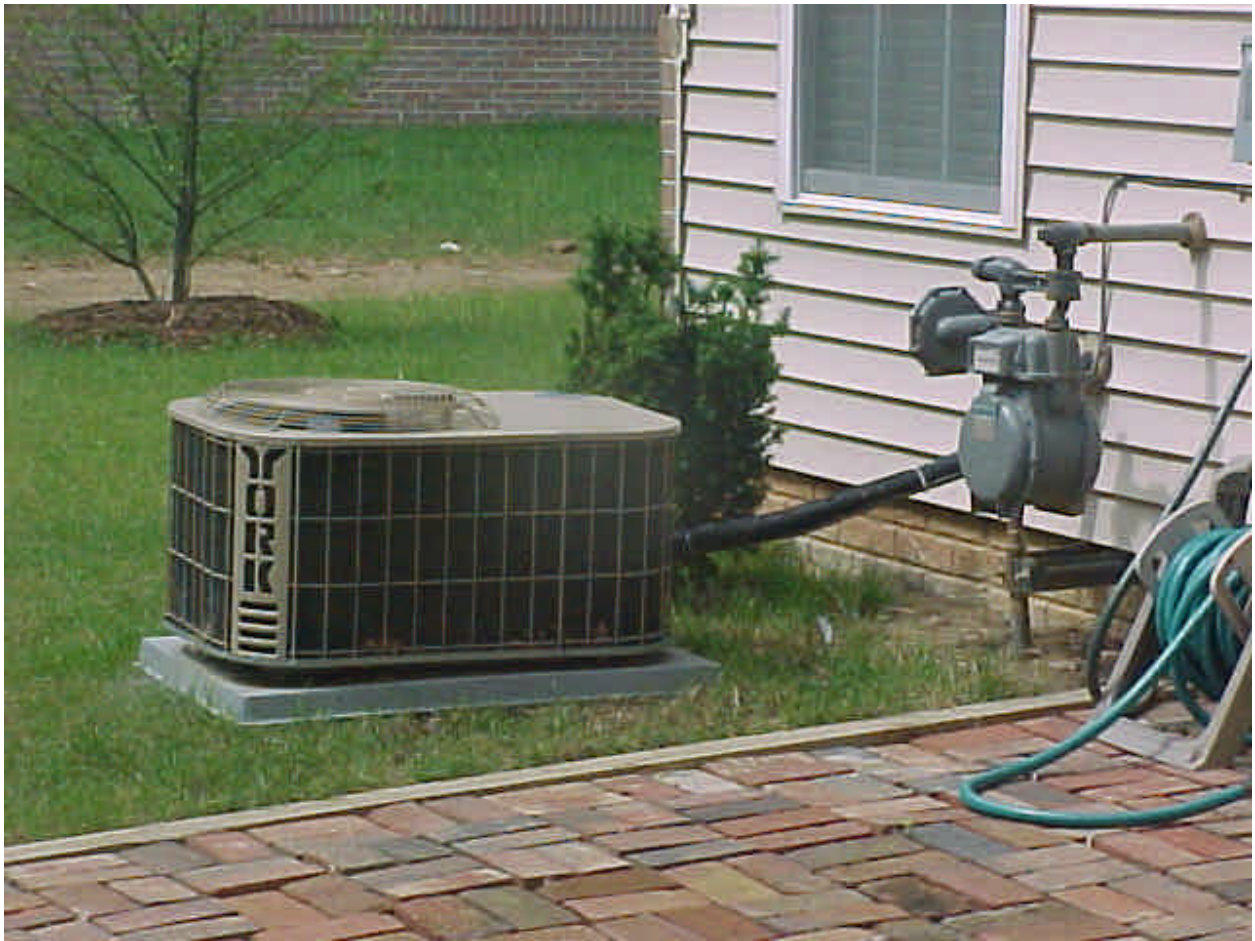
(See following 9 pages)

Flood Risk No. 1



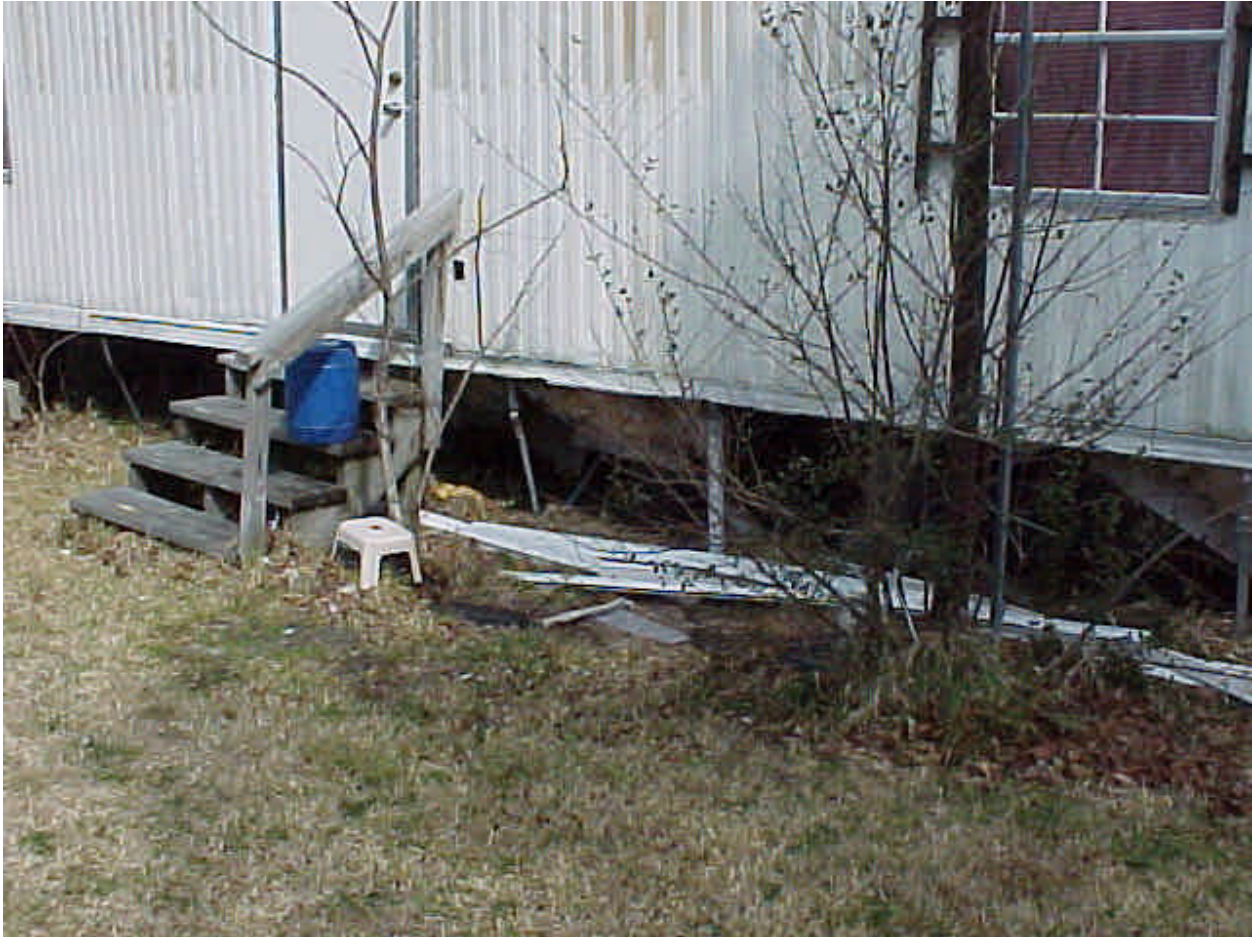
Scenario – Base Flood Elevation 1 foot above existing ground

Flood Risk No. 2



Scenario – Base Flood Elevation at ground level

Flood Risk No. 3



Scenario – Base Flood Elevation 3 feet above ground level

Flood Risk No. 4



Scenario – Base Flood Elevation at ground level

Flood Risk No. 5



Scenario – Base Flood Elevation 3 feet above ground level

Flood Risk No. 6



Scenario – Base Flood Elevation for this well housing is 1 foot above ground level

Flood Risk No. 7



Scenario – Base Flood Elevation at ground level

Flood Risk No. 8



Scenario – Base Flood Elevation at ground level

Flood Risk No. 9



Scenario – Base Flood Elevation 1 foot above ground level

Unit 3: Recognize the Risks and Mitigation Measures

	Flood Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may not necessarily be visible in the photo.

Flood Answer Sheet	
Picture Number	Action Checklist Number
1	103, 104, 105, (would consider 107 if BFE was higher; never wetproof a manufactured home)
2	104, 106, 107 (would consider 105 and 109 if BFE was higher)
3	105, 107, 108
4	102
5	105, 108 (never apply protective sealants to crawlspaces)
6	101, 109
7	102
8	103, 104, 106, 107, 109 (would consider 105 if BFE was higher)
9	103, 106, 108, 109, 110

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Wind (See following 10 pages)



Wind - 201

Reduce potential for flying debris

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

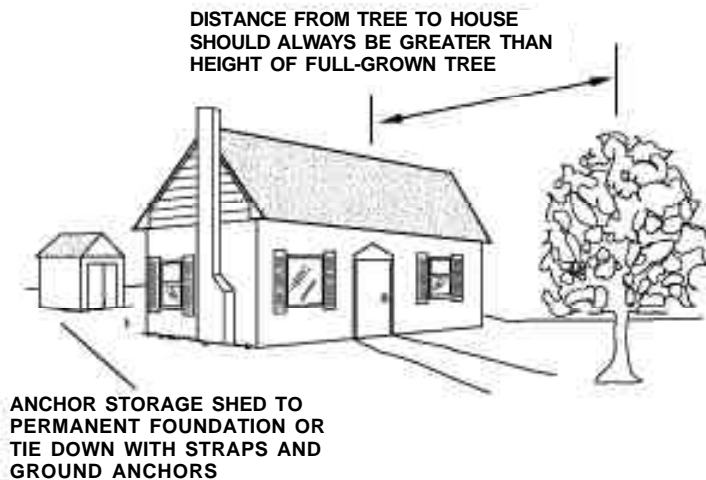


Outdoor furniture, trees, trash cans, yard debris, outbuildings, or other materials in the immediate vicinity of your home, that can be moved by the wind, are a threat that increases the risk of danger to your home during a hurricane or tornado. The wind can topple trees and tree limbs onto your house. It can also pick up smaller objects and drive them through windows and doors. Another danger is that wind can tear inadequately secured downspouts from your home.

In addition, loose shingles or other building components can fly off and increase the susceptibility of damage to your home. A small breach of the building envelope may lead to severe damage.

Mitigation Measure

You should remove dead and dying trees and potential windborne missiles like outdoor furniture. Also, make sure that all trees are far enough away from your home so that they can't fall on it. That means the distance between your home and any unhealthy tree should always be greater than the height of the tree. Prune dead or dying tree limbs and remove unhealthy large trees, if necessary. You should also clear away any debris, such as fallen tree branches.



All storage sheds and other outbuildings should be securely anchored, either to a permanent foundation or to the ground with straps and ground anchors. The same straps and ground anchors used for manufactured homes also can be used to anchor outbuildings, especially small garden sheds, which are usually not placed on a permanent foundation. Use the same method for home attachments, such as downspouts and TV antennas or dishes. Use strapping to securely fasten them to the home or ground so that they do not detach.

Smaller objects, such as trash cans, barbecue grills, and outdoor furniture, should also be anchored or, if you have adequate warning, moved indoors. You can secure trash cans with cables or chains attached to ground anchors or to wood posts firmly embedded in the ground. Fasten trash can lids to cans with chains or cables.

Notes:



Wind - 202

Anchor the base of your manufactured home

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

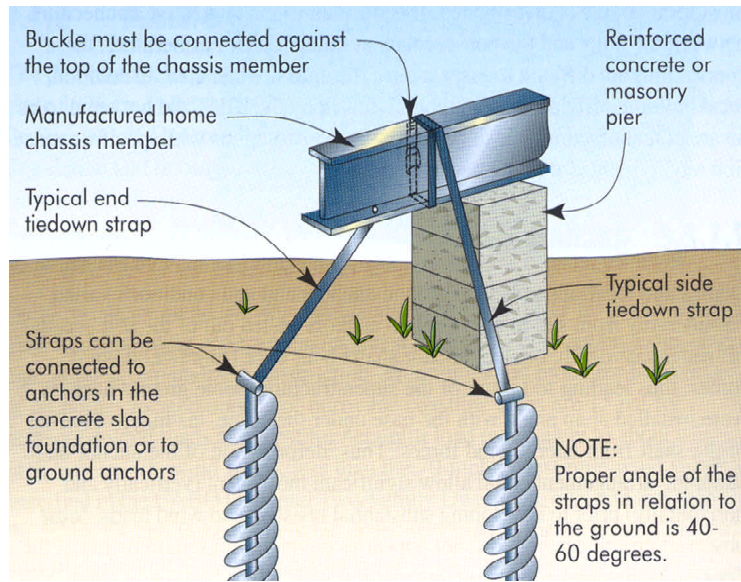
Potential Hazard



During periods of sustained high winds, a manufactured home can easily become dislodged from its foundation and, as a result, even collapse. Besides the obvious structural damage, your interior goods could also be damaged. Homes in coastal areas subject to hurricanes and in inland areas subject to tornadoes are possible candidates for mitigation. Even homes in northern states that typically do not have tornadoes or hurricanes can be subject to strong, straight-line winds that can be just as destructive as a hurricane or tornado.

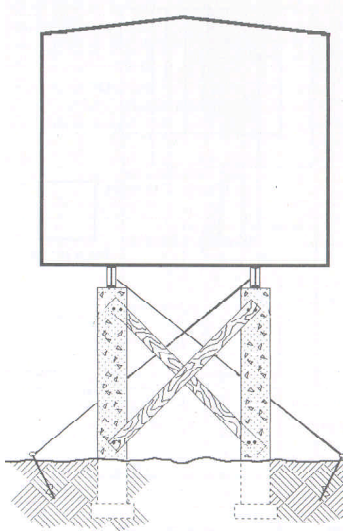
Mitigation Measure

The stability of a manufactured home can be increased by securing it to the ground or a heavy concrete foundation. Before determining the securing strategy, you must have site-specific flood information which may also include the base flood elevation. This information will help you determine how likely or to what depth your immediate area will experience flooding.



A manufactured home can be secured in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type should be selected for **the applicable soil type**. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information on anchoring tips.

A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately after consideration of the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability. Also, the home should not rest on “dry blocks.” Use steel reinforced blocks filled with grout or concrete by temporarily raising or jacking up the home. Then insert reinforcing steel into the concrete masonry units and filled with grout.



A manufactured home that rests on fill material, such as soil, is less likely to catch wind from underneath, but it should be anchored to the foundation by ground anchors.

A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts spaced at four feet or less and sufficiently embedded.



Wind - 203

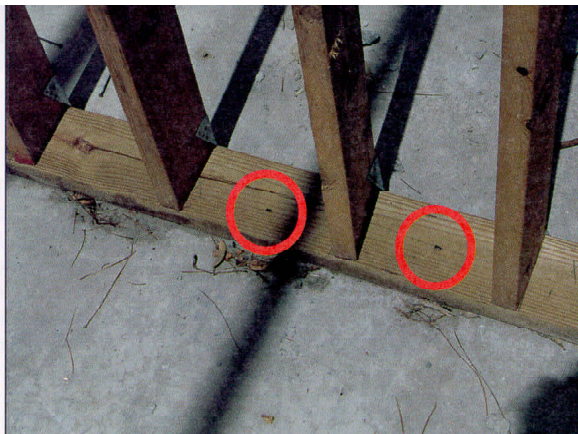
Bolt your house sill plate connection

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.

Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.



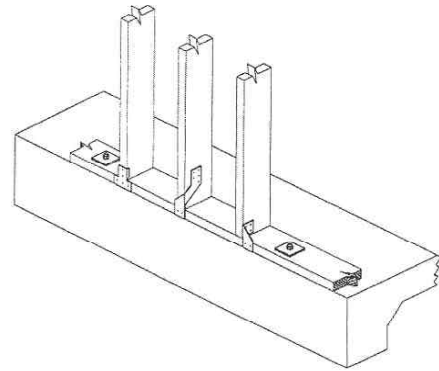
Potential Hazard



If your home is not adequately anchored to its foundation, it may become dislodged from its foundation from the force of strong winds. If your home is pushed off its foundation, it is more likely to experience structural failure. Many homes have wood framing and lightweight covering materials that can be easily lifted or moved. To make your home more resistant to the lateral and uplift forces of wind, you need to be sure that all parts of your home are firmly interconnected.

Mitigation Measure

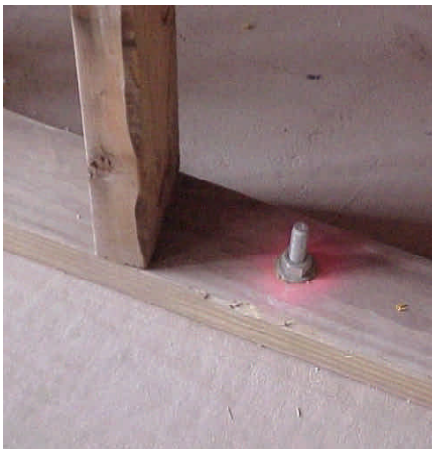
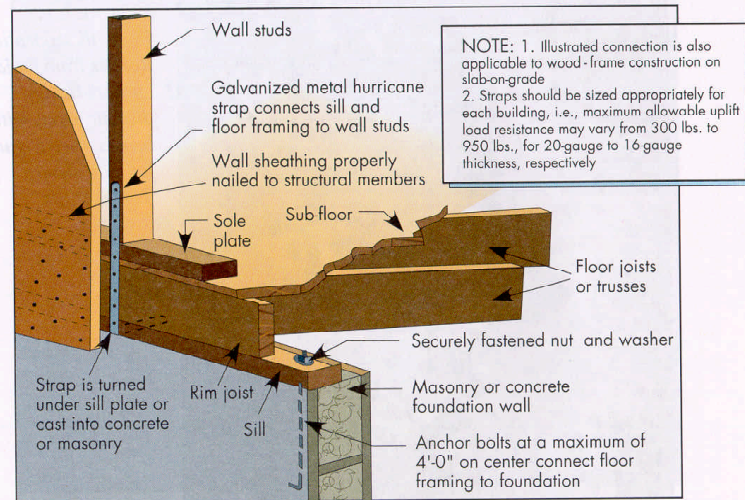
The best protection from these dangers is to secure your home to the ground or a heavy concrete foundation that transfers the lateral and uplift loads from the roof and walls of your home to its foundation.



A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts no more than four feet apart, according to the manufacturer's installation instructions. The wall studs also should be secured to the base plate and foundation with straps. For existing homes, use concrete anchors to attach the strap to concrete. To properly seat a concrete anchor, which is a special type of screw, a hole must be predrilled into the masonry $\frac{1}{4}$ " deeper than the anchor. The anchor can then be screwed in by using a power drill with a screw bit.

Whether you live in a detached home with a crawl space or a manufactured home, you can secure your home in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the

ground by anchors whose embedded length and type should be selected for the applicable **soil type**. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information on anchoring.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately after consideration of the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability.



Wind - 204

Increase your gable end bracing

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

During a windstorm such as a hurricane, homes with gabled roofs are more likely to suffer damage than those without gables. Each end of a gabled roof is shaped like an “A,” with the outside walls extending to the peak of the roof. During a strong windstorm, those walls take a beating, so gables that are not properly braced can collapse and cause major damage to the roof.



Gabled roofs are more susceptible to damage by high winds than hip roofs or flat roofs. The wall on a gabled end presents a large surface to the wind and receives its full force. If the framing of the gabled ends and the rest of the roof are not adequately braced to resist the wind, the wall can buckle or fall, and then the roof can fail. Roof failures, especially for unbraced gabled roofs, are a common cause of major damage to homes and their contents in high winds.

Mitigation Measure

If your house has a gabled roof, you should check to see whether the roof framing is braced. After inspecting your roof framing, a building official can tell you whether additional bracing is required.



One method of gable end bracing consists of 2x4s placed in an “X” pattern from the top center of the gable to the bottom center brace of the fourth truss, and from the bottom center of the gable center to the top center brace of the fourth truss. Use two 3” 14-gauge wood screws or two 16d (16 penny) galvanized common nails to attach the 2x4s to the gable and each of the four trusses. See attached figure for an example of proper bracing.

Notes:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



Wind - 205

Replace gable vent with slotted vent

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



Wind breaking into your house during a windstorm is particularly hazardous because it can break apart your roof and walls. A small breach of the building envelope may lead to severe damage to your home. Wind and rain coming in also can damage the interior contents of your home.

Mitigation Measure

It is recommended that you provide venting with adequate openings to relieve induced pressures on your roof structure. However, be

sure the venting you install prevents the entry of uncontrolled airflows. Such uncontrolled airflow could result in buildup of induced internal air pressure, which is also dangerous. It is desirable to use a power-operated vent that can be opened during normal weather and closed during storms to prevent uncontrolled winds from entering.



Notes:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



Wind - 206

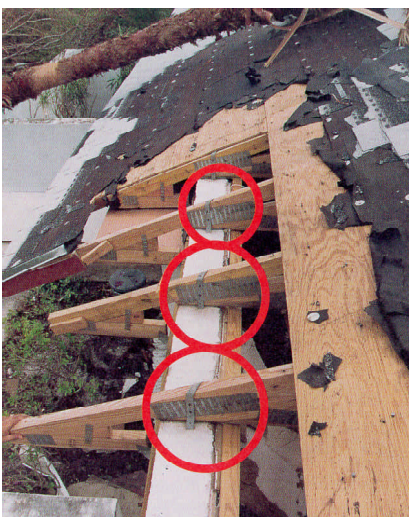
Fasten your roof & walls with hurricane straps

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



During a windstorm, the force of the wind pushes against the outside of your home. That force is passed along from your home's roof to its exterior walls and then to its foundation. Homes can be damaged or destroyed when the energy from the wind is not properly transferred to the ground.

In most homes, gabled roofs are built from manufactured rafters. Sheets of roof sheathing, often plywood, are fastened to the rafters with nails or staples, and roofing material is fastened to the sheathing. In many cases, the rafters are held in place only by the plywood on top. This arrangement may not be enough to hold the roof on your home during a strong windstorm like a hurricane.

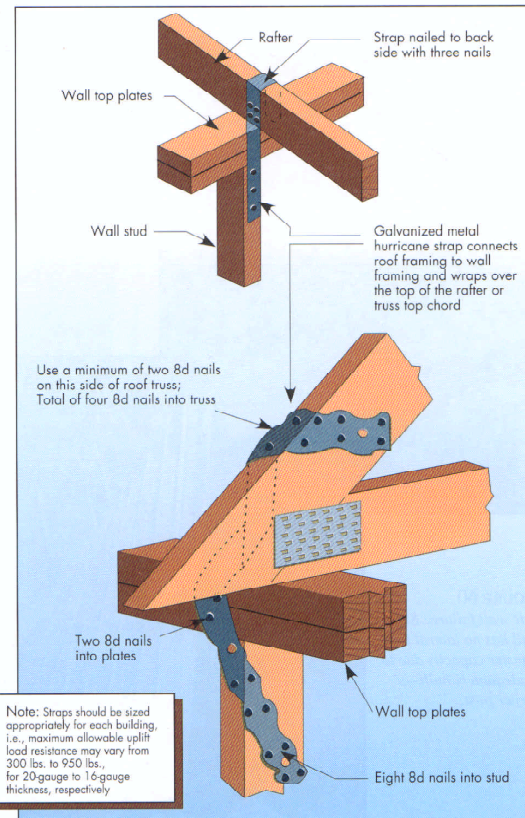
Mitigation Measure

To improve the connection between your home's roof and its walls and foundation and thus reduce the risk of losing your roof to high winds, you should install hurricane straps or clips. Hurricane straps or clips will help hold any type of roof to the walls. Inspect your attic for hurricane straps or clips of galvanized metal.

To install hurricane straps or clips, remove the roof sheathing around the edge of the roof to reveal the horizontal underside of the eave. Also remove the exterior covering to reveal the top 12" to 18" of the wall. If the exterior covering is brick veneer, you may need to remove small sections of brick.

If your roof has trusses, make sure you tie them to the wall either by anchoring them to the top plate and then the top plate to the wall stud, or strapping the truss directly to the wall stud. You can anchor the roof to the top of the wall of wood or masonry homes with straps or connectors.

Similarly, for two-story buildings, the upper story should be secured to the lower floor level. Use at least four 8d nails to secure the galvanized floor tie anchors to each of the top floor studs, floor joists or trusses, wall top plate, and first floor wall studs. To secure the straps or clips to wood, use a minimum of two 8d nails on either side of the truss for a total of four 8d nails. In addition, use two 8d nails to secure the strap or clip to the spine of the truss, if possible. Use two 8d nails to secure the strap or clip to the wall top plates. Use eight 8d nails to secure the strap or clip to the wall stud.



If you need to connect the strap or clip to masonry, you can use concrete anchors, which are screws designed for concrete embedment. Predrill holes for the anchors $\frac{1}{4}$ " deeper than the anchor to allow for dust from predrilling. Concrete anchors $\frac{1}{4}$ " in diameter and $2\frac{1}{4}$ " or $2\frac{3}{4}$ " long should be sufficient. Power tools are recommended for seating the screw.



Wind - 207

Improve the securing of your roof sheathing

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

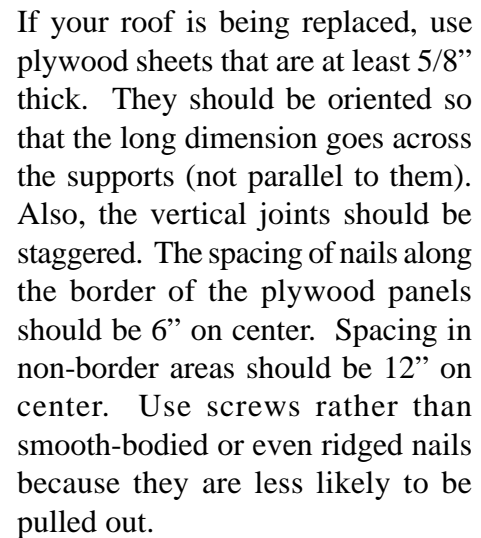
During a windstorm, the force of the wind pushing against the outside of your home is very strong. Roof systems are particularly vulnerable to strong winds because they are elevated



and thus, very exposed. The force from the wind is passed from your roof to the exterior walls and then to the foundation. Homes can be damaged or destroyed when the energy from the wind is not properly transferred to the ground.

In most homes, gabled roofs are built using manufactured rafters. Sheets of roof sheathing, often plywood, may not be enough to hold the roof on your home during a strong windstorm like a hurricane.

Roof sheathing can be reinforced from underneath without removing a roof that is in good condition. You can fasten the brackets into place with screws, nails, or a high-strength adhesive. Make sure the screws or nails do not puncture or pass through the plywood sheathing. If you use a high-strength adhesive, you may need to insert a shim to create a little space where you can shoot the glue. Be sure the high-strength adhesive you choose has the product approval code AFG01, which will appear on its packaging; that is your assurance that the product is suitable for this purpose.

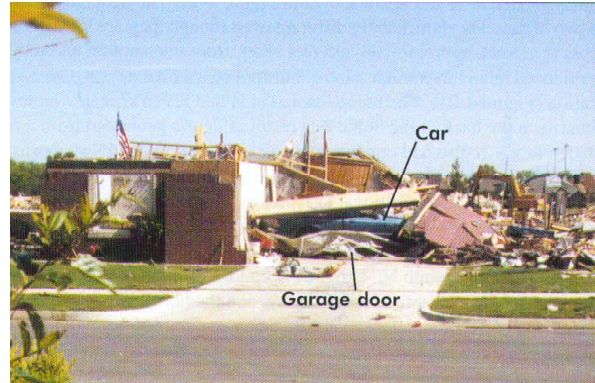
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Wind - 208

Improve closure of your windows and doors

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

Strong wind events can cause damage for many reasons. The outside walls, doors, and windows are the protective shell of your home. If that protective shell is broken, high winds can enter,

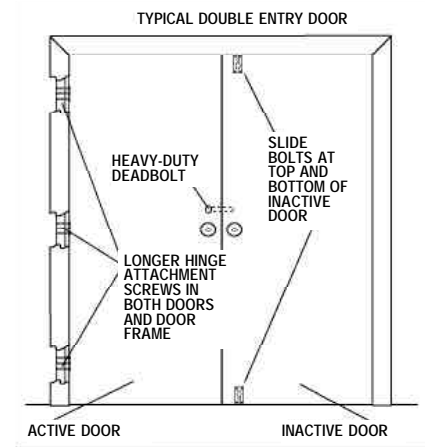
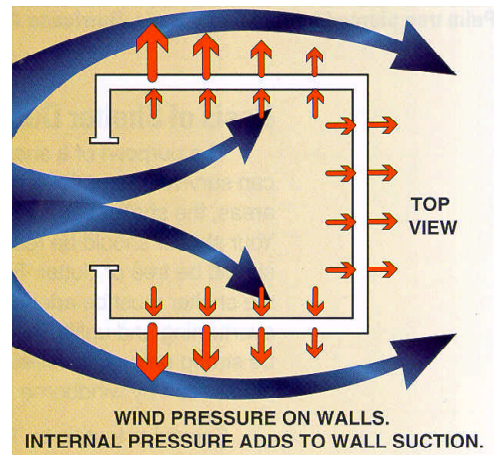


put pressure on your home's roof and walls, and push them apart. Also, the wind can carry heavy objects and debris, which can then become deadly missiles. In hurricanes and tornadoes, pressure differences between the inside and outside of your home can cause windows to shatter and break. Rain which heavy winds drive through a broken window into your home can be a major cause of damaged household goods. Shards of broken glass could also cause painful and severe injury or death to you and your family.

A common misunderstanding is that windows should be left open to equalize and stabilize pressure on your home. The truth is that if hurricane winds enter any opening, damage is much more likely to occur because of the increased internal pressure on walls and roof supports.

Mitigation Measure

You can protect your home by strengthening its doors and windows. Make sure all windows, doors, and openings are fitted with bolts and impact resistant materials. Adding slide bolts and dead bolts to your windows and doors will also increase your family's general security. Safety window film will hold glass shards in place, thereby reducing potential injuries, deaths and property loss from flying glass. If you use tinted safety glass, you will increase the energy efficiency of your home by reducing the effect of solar heat in summer and retaining heat in winter. You can add tinting to a window or door that already has safety glass.



Replacement of your windows and sliding doors is probably most beneficial in coastal areas where the threat from high winds occurs regularly. However, inland areas also frequently experience strong winds. If your home is in a high-risk area from strong winds and a window or door needs replacing because it does not close properly, it may be beneficial to replace it with one that is impact-resistant. Because the impact-resistant products are relatively new, you should consider replacing only standard-size windows and sliding glass doors.

Notes:



Wind - 209

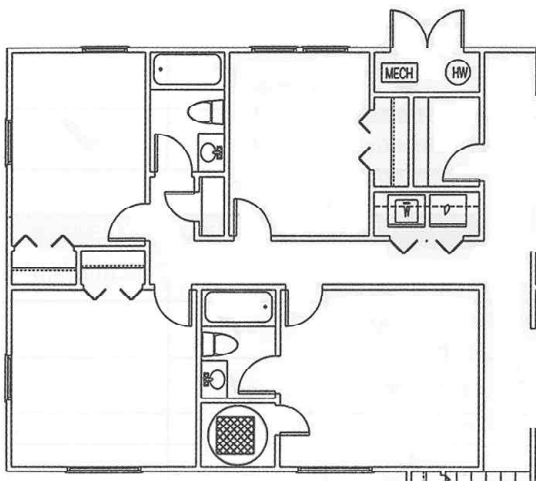
Create a safe area in your home

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



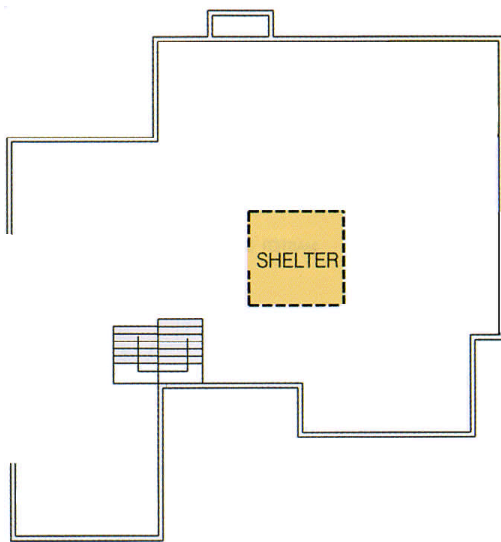
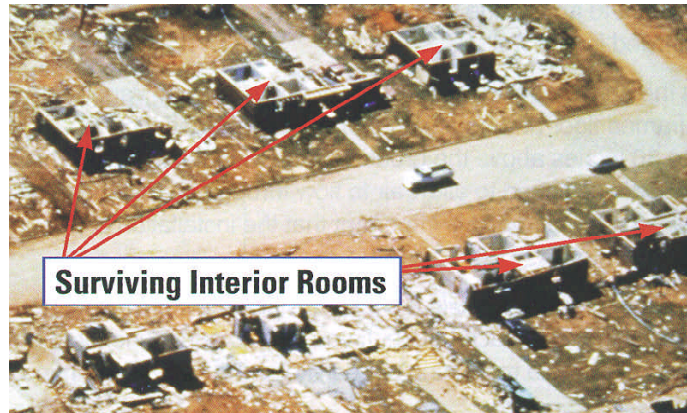
Mitigation measures can help reduce damage to property caused by extreme winds. However, even after you apply mitigation measures, you still face risks to life and property. Modern technology has provided warning of hurricanes early enough so that coastal areas can be evacuated before storms arrive. Unfortunately, hurricanes also can travel far inland and cause great damage. With tornadoes, nor'easters, and straight-line winds, though, there often is little warning. However, you can reduce the number of lives lost by protecting yourself and your loved ones inside your home.

Mitigation Measure

Residents of tornado and hurricane-prone areas can build a “safe room” or in-residence shelter as protection against deadly tornadoes and hurricanes. A safe room, or in-residence shelter, is a small windowless room, such as a closet or bathroom, readily accessible from all parts of the house, designed to provide protection for your family. Its purpose is threefold - to save lives, reduce injuries, and relieve anxiety.

The safe room is appropriate for both existing residences and newly constructed homes. *Taking Shelter from the Storm: Building a Safe Room Inside Your House*, FEMA Publication 320, outlines a room shelter design, including construction plans, materials, and cost estimates. One free copy of this document is available to each homeowner by calling 1-800-480-2520. The publication was developed by FEMA with Texas Tech University’s Wind Engineering Research Center, Lubbock, Texas.

Research from inspections of homes in more than 90 towns and cities which were struck by tornadoes revealed that, in most cases, small rooms in the central portion of the house remained



standing even when the rest of the house was severely damaged or completely destroyed. This realization led to the conclusion that these interior rooms could be reinforced to provide a high degree of occupant protection at a reasonable cost. A shelter built according to the FEMA Pub. 320 plans can provide protection against winds of up to 250 miles per hour and flying objects traveling at 100 miles per hour.

If you live in an area where there are tornadoes and hurricanes, consider constructing a safe room in your home. Remember: mitigate now—before the next windstorm—to save lives later.



Wind - 210

Improve the bracing of your “A” frame roof

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



Because the roof is the highest point of a home, it will likely suffer great stresses and loads from windstorms, like hurricanes, tornadoes, straight-line winds, and nor'easters. Keeping the roof on your home is the first, and maybe most important, step in weathering the storm. If your roof comes off or fails partially, damage to your interior contents is almost a certainty.

To see what sort of bracing your roof's rafters have, go into your attic. If the attic does not have a floor, be careful to walk only on the wood joists. Also, notice how the plywood is attached to the rafter system

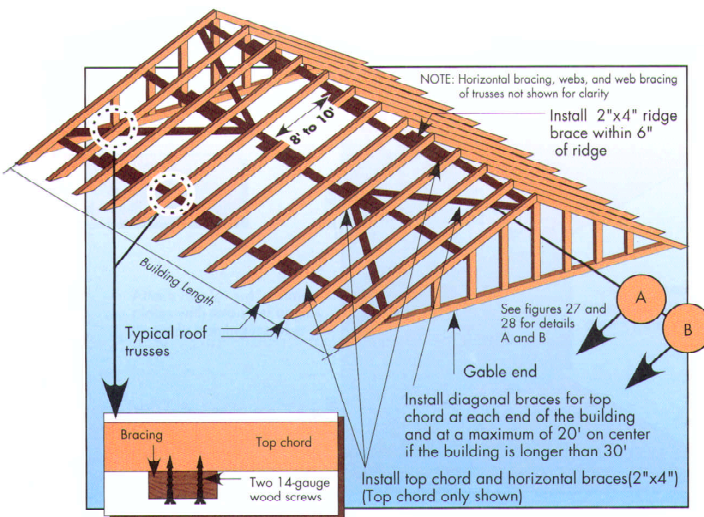
For an A-frame roof, sheets of roof sheathing, often plywood, are fastened to the rafters with nails or staples, and roofing

material is fastened to the sheathing. If most of the large nails or staples coming through the sheathing have missed the rafters, consider having the sheathing properly installed. (See Fact Sheet 207.)

In many cases, the rafters are held in place only by the plywood on top. This arrangement may not be enough to hold the roof in place during a strong windstorm like a hurricane. Installing additional bracing makes your roof's rafter system stronger.

Mitigation Measure

If your house has a gabled roof, you should check to see whether the roof framing is braced. If you are unsure whether your gabled roof is adequately braced, make a quick inspection. If you do not see any wood perpendicular to the rafters, then they have no bracing at all. The guidelines below indicate the minimum bracing needed.



In gabled roofs, bracing usually runs the length of the roof. If you do not have bracing, it should be installed. You can do this yourself or hire a professional. Install 2x4s the length of your roof, overlapping the ends of the 2x4s across two trusses. (See Figure.) Braces should be installed 18" from the ridge, in the center span, and at the base, with eight to ten feet between the braces. Use two 3-inch, 14-gauge wood screws or two 16d (16 penny) galvanized common nails at each rafter.

Because space in attics is generally limited, screws may be easier to install. Always use screws that are at least two inches long and install them in pairs to be sure the connection is secure.

Notes:

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Wind Exercise Sheet
Assess Wind Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Wind Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

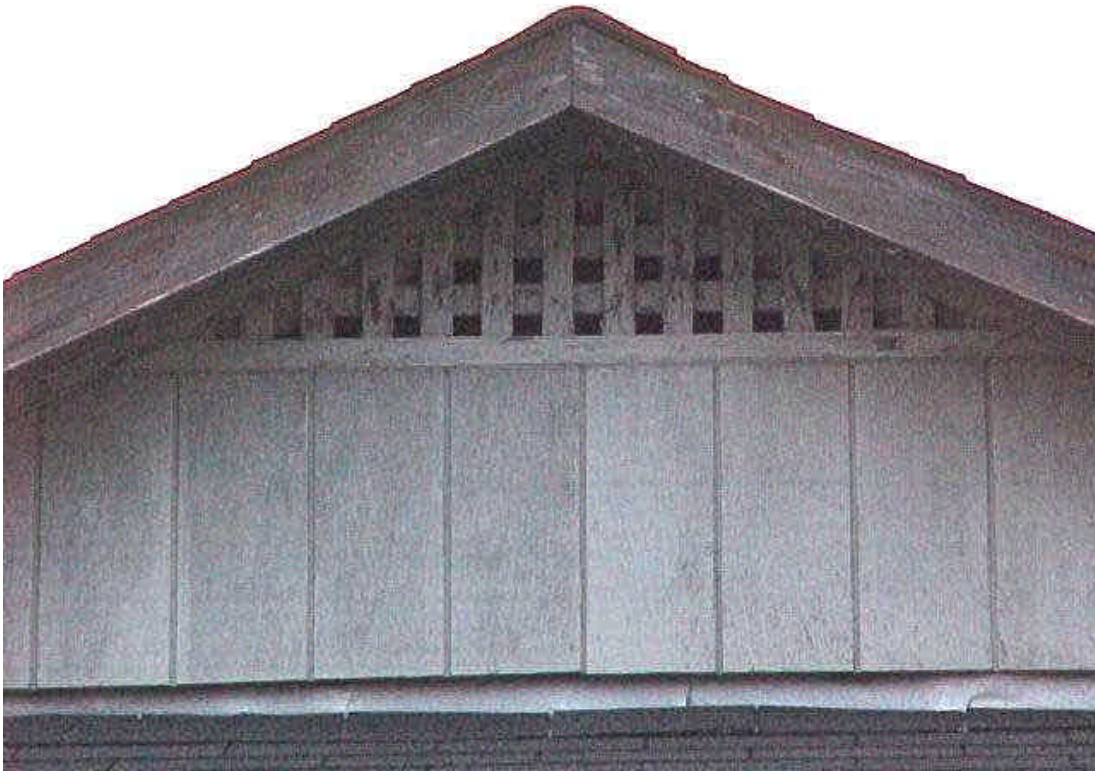
Wind Risk Pictures

(See following 10 pages)

Wind Risk No. 1



Wind Risk No. 2



Wind Risk No. 3



Wind Risk No. 4



Wind Risk No. 5



Wind Risk No. 6



Wind Risk No. 7



Wind Risk No. 8



Wind Risk No. 9



Wind Risk No. 10



Unit 3: Recognize the Risks and Mitigation Measures

	Wind Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Wind Answer Sheet	
Picture Number	Action Checklist Number
1	204, 206, 207, 210
2	204, 205, 206, 207, 210
3	201, 206, 207
4	201, 202, 208
5	201
6	201, 202
7	201, 206, 208
8	201, 202, 208
9	201, 202
10	210, 206

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Earthquake

(See following 10 pages)



Earthquake - 301

Install a gas safety cut-off valve

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

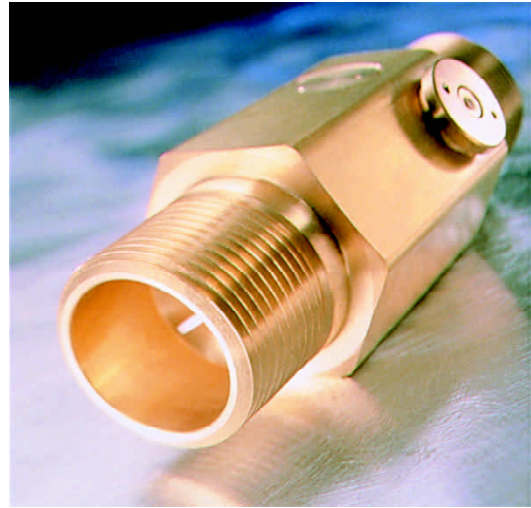
Potential Hazard



An earthquake is movement of the earth's crust that causes the ground to shake or tremble. As a result, earthquakes often damage gas pipes. Gas pipes can be damaged from even minor earthquakes when they crack or split, or when your appliances shake or are knocked over because your home shifts. Then natural or propane gas may escape into your house and create a serious threat of fire or an explosion. Injuries to you, your family, your home, your neighbors, and the environment may result.

Mitigation Measure

If you are replacing a portable kerosene heater or putting in bottled or tank based propane or natural gas heating systems, then a gas safety cut-off valve is an appropriate and good low-cost mitigation measure for reducing the risks of a gas leak into your home. One such device is the Sanders Safety Cut-Off Valve, which is installed on your gas pipe outside the home. The Sanders Valve has been approved by the American Gas Association. This self-contained, one-inch valve fits on the low-pressure side of the regulator leading to a gas pipe. Its spring stops the flow of gas whenever there is a break in the pipe or a drop in gas pressure, which may happen when there is an accident or natural disaster. Because the valve is placed in-line above ground, it is easy to determine if a home already has one installed. One needs only to find the gas meter or propane tank and see if the valve is in line near to the meter or the tank.



Installing the valve has many benefits to you. It shuts off the gas flow at the first sign of a gas pipe break or pressure drop, and the valve remains closed until inspection and repairs have

been completed. Thus it removes the danger of gas escaping into your home and causing a fire or explosion. The valve does not require any special attention from you because it automatically resets after repairs have been made. Also, it is weather resistant and does not require any power to operate, so it is very cost-effective. Because it is adaptable to a wide range of situations, it can be installed without any digging on your property.



Besides providing protection during an earthquake, the cut-off valve also provides protection for pipes damaged during a flood.

To assemble, install, or service the Sanders Safety Cut-Off Valve, a state-certified plumbing and heating technician or gas utility technician will be required. It should be noted that the valve will work for high or low pressure systems and is easily set.



Earthquake - 302

Brace your manufactured home

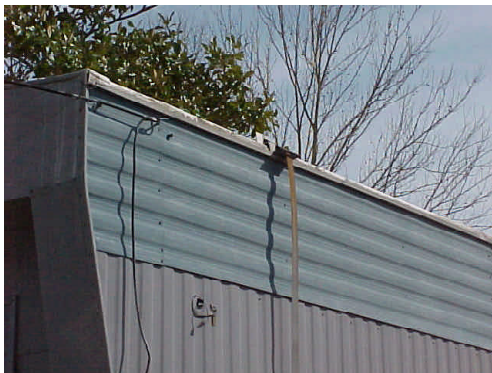
Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

Manufactured homes and modular buildings not attached to permanent foundations need special consideration when located in earthquake-prone areas. These structures can slide or topple off their foundations if not properly secured to resist shaking and require reinstallation. Manufactured homes are seldom destroyed by earthquakes; however, they are often damaged. Even moderate earthquakes may dislodge these homes from their support system (piers), allowing them to fall to the ground. Accessory structures such as awnings, decks, skirting, etc., are racked and twisted beyond repair when the home shifts off the support piers. Earthquake-related fires are usually the cause of destroyed manufactured homes during



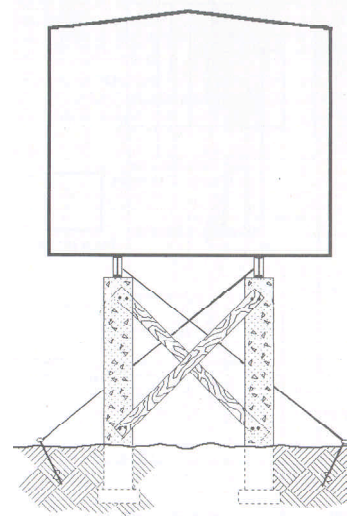
earthquakes. Fires typically originate from a ruptured gas line where it connects to the home or to an appliance. Manufactured homes are required to have gas lines secured in place. However, many times when a homeowner replaces appliances, they are not secured and become the source of ignition when the gas connection is broken or ruptured by earthquake shaking.

Mitigation Measure

Special earthquake stabilizing devices for manufactured homes are available. Check with earthquake retrofit specialists in your area. These devices have proved to be effective in preventing or minimizing damage in several recent earthquakes.

Structural engineers advise that four precautions will improve the earthquake readiness of a manufactured home. Keep the axle, wheels, and inflated tires on the unit; reduce interior hazards in the same way as for other housing; install an earthquake safety device to keep the unit from falling off its supports; and install an automatic gas shutoff valve (Fact Sheet 301).

Many states have different requirements for bracing. You should contact your local Housing and Community Development office for more details. However, the California Department of Housing and Community Development (HCD) certifies Earthquake Resistant Bracing Systems for manufactured homes. These systems have been found to substantially reduce damage to homes from earthquakes. Manufactured homes can be secured in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type should be selected for the applicable soil type. See FEMA 85 – *Manufactured Home Installation in Flood Hazard Areas* for more information.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately for the soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood cross pieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wooden or steel rods and provides even greater stability.



Earthquake - 303

Bolt your house sill plate connection

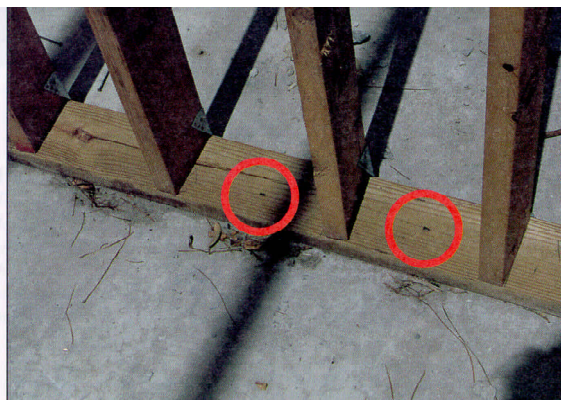
Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

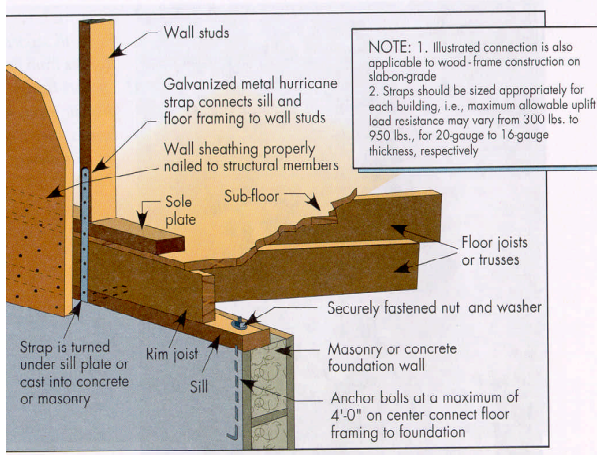
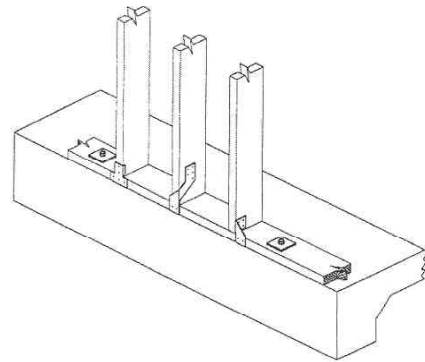
Potential Hazard

The sill plate of a house rests directly on top of its foundation. It is usually a wooden 2"x 6" or 2"x4" board that runs the length of the foundation upon which the floor or cripple wall of a home stands. If the sill plate for your home is built on a cripple wall and crawl space foundation, your house will be especially susceptible to earthquake damage. If the sill plate is not securely anchored, an earthquake can cause it to shift on the foundation. When this shifting occurs, there is a significant potential for severe damage to your home as well as injury to you and members of your family. The picture to the left illustrates an inadequately secured foundation that used nails instead of bolts.



Mitigation Measure

The best protection from problems associated with your home's shifting is to secure your house to the ground or to a heavy concrete foundation. This action will transfer lateral loads from the walls of your home to its foundation. First, one must determine if the sill plate has already been secured. To conduct an inspection if the house rests upon a cripple wall, you will need access to the crawl space under the house. Upon entering the crawl space, look for evidence of bolts going through the wood sill and into the foundation. A home on a conventional foundation is a little harder to inspect. Not infrequently, however, it is possible to perform a limited inspection. Sometimes you can remove the ventilation screens and, using a flashlight, visually inspect the area where the sill plate meets the foundation.



A typical single family home should be secured to its foundation through its wooden sill or base plate with $\frac{1}{2}$ " diameter anchor bolts which penetrate several inches into the foundation and are spaced at four feet or less along the base of the exterior walls. This method is not limited to cripple wall construction; it can also be used for a house built on a basement or slab-on-grade foundation or on another type of crawl space foundation.





Earthquake - 304

Brace your cripple walls

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

A cripple wall is a short wall between the foundation and its main structure. The cripple wall is usually between one to two feet high. This usually means that the home has a crawl space underneath. This cripple wall supports the floor and exterior walls. An unbraced cripple wall can shift during an earthquake and the house could fall off its foundation. Even a minor earthquake can cause the cripple wall to crack, buckle, or crumble, thus undermining the home's stability. If your house is built on a cripple wall foundation, brace the cripple wall to increase your home's structural stability and reduce earthquake damage.



Mitigation Measure

Diagram illustrating the construction details of a foundation and wall assembly, showing the relationship between various components:

- EXTERIOR SIDING
- EXISTING BLOCKING BETWEEN JOISTS
- SUBFLOOR
- FLOOR JOIST
- NEW PLYWOOD OR ORIENTED STRAND BOARD
- NEW BLOCK AT TOP AND BOTTOM OF CRIPPLE WALL
- CRIPPLE WALL STUD
- SILL PLATE
- FOUNDATION

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Earthquake - 305

Brace your masonry chimney

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.

Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.



Potential Hazard

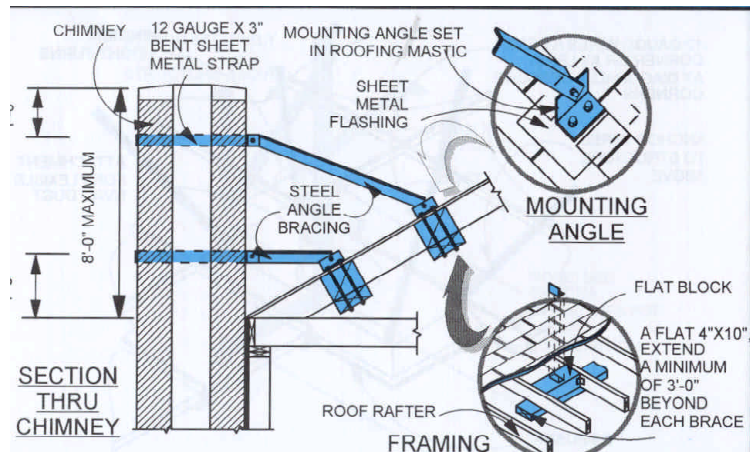


Chimneys installed before 1960 may not be properly reinforced and tied to the building. Be especially careful about very tall chimneys, which could fall in the direction of an exit path. Or worse, the chimney could fall onto the home. Usually when this happens to brick chimneys, the heavy weight crashes through the roof and into the home as illustrated by the picture above. When checking the chimney to see if it is already strapped, be careful not to confuse strapping used to secure an

antenna as straps used as part of chimney bracing like in the photo to the left.

Mitigation Measure

To protect the investment you made to the roof like insulation, strengthened roof sheathing, or truss bracing, increase the security of your masonry chimney. If the top of the chimney is flush with the roof, the chimney is probably not worth retrofitting because of its decreased likelihood of falling. Chimneys that extend beyond the roof line should be secured in high earthquake risk areas. To increase the safety of your chimney during an earthquake, first reinforce the sub-roof around the chimney with 2"x4" boards that are perpendicular to the roof rafters or trusses. Use at least two 16d nails to secure it to each rafter and 1/2" diameter bolts to go through the roof into the added 2x4's. This shoring up is needed to anchor the chimney braces. Braces consist of 2" wide 16 gauge steel straps. At least two should be used – one at the top of the chimney and one at or just above the roof line. The straps are secured to the roof with angle 2"x2"x1/4" steel angle braces. Refer to the sketch above for a graphic illustration. This strapping should mitigate the shaking effects of earthquakes upon your chimney. Furthermore, be sure to seal the areas around where you have penetrated the roof with bolts.



After an earthquake, be sure to check and repair the chimney as needed.

Notes:



Earthquake - 306

Use flexible connections for gas and water

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

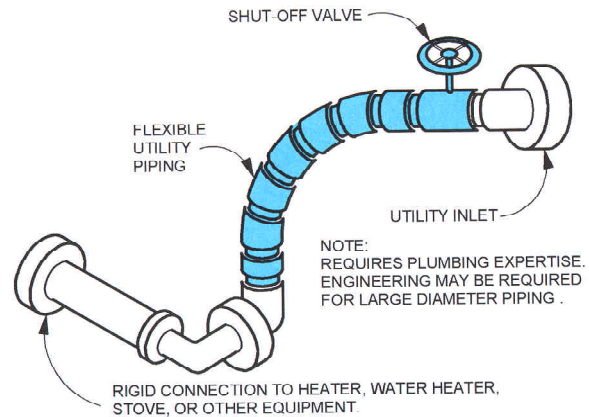


Most water and gas supply lines have rigid pipes and connections. These lines can be torn away or ruptured during an earthquake. The results could include not only serious damage to your house but also injury to you and members of your family. A broken water line can flood the house interior and damage appliances and furnishings. The water could also short circuit and start a fire. A broken gas line is especially serious because the escaping gas will slowly accumulate and could cause a

fire or explosion. Even if no explosion occurs, the gas will slowly displace breathable air and cause a life-threatening atmosphere.

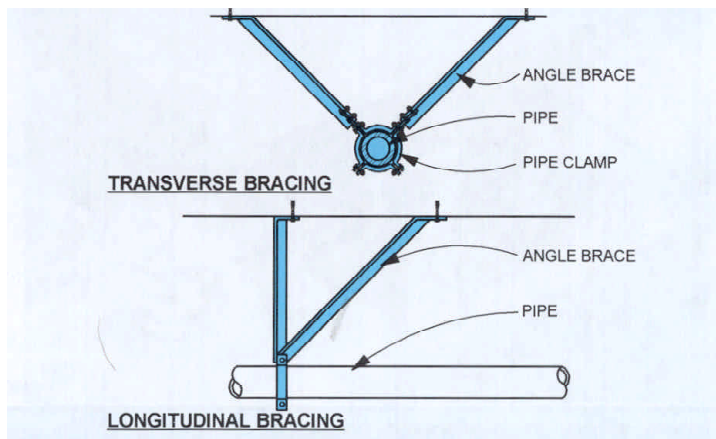
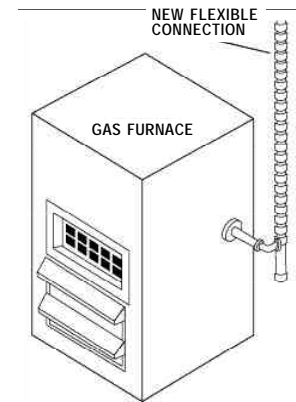
Mitigation Measure

One way to prevent broken gas and water lines is to have flexible connectors installed between appliances and their supply lines. The diagram shows a flexible connector installed on a gas furnace. You can also use a flexible connection for other appliances, such as a hot water heater, clothes dryer or stove. Only a licensed contractor should install this connection.



Flexible connectors will help reduce the risk of gas and water lines being damaged as a result of shaking during an earthquake. Installing flexible connectors should not be done instead of bracing or strapping. Flexible connectors will not help if an appliance, such as a water heater topples over; they will only help to mitigate the effects of shaking.

The supply pipes that connect to your appliances also need to be protected. This is a particularly simple mitigation measure when installing a new heating appliance or refurbishing an old one. Install brackets or angle bracing to keep the rigid pipes from moving as illustrated below.





Earthquake - 307

Strap your water heater

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



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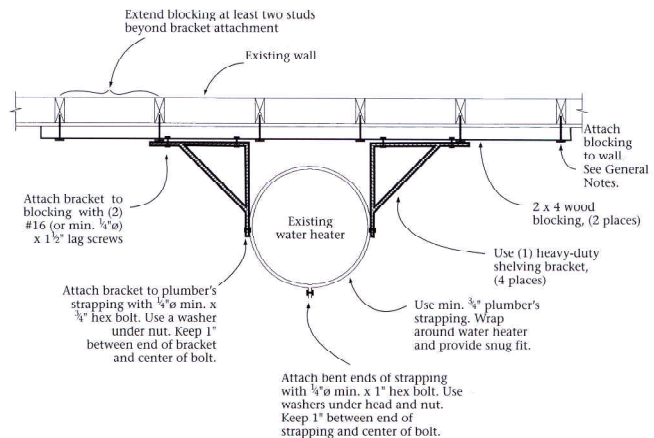
Potential Hazard



A standard water heater is the home appliance most likely to have earthquake damage because it has a high center of gravity. Although modern water heaters have been designed to be more stable than the early models, they are still likely to “walk” or even tip over during an earthquake. If this movement happens, your utility lines may be disconnected. The results may include gas or water leakage, electrical shorts, fires, or explosions. Also, if your water heater does tip over, you could lose one of your best sources of water for the period following the earthquake.

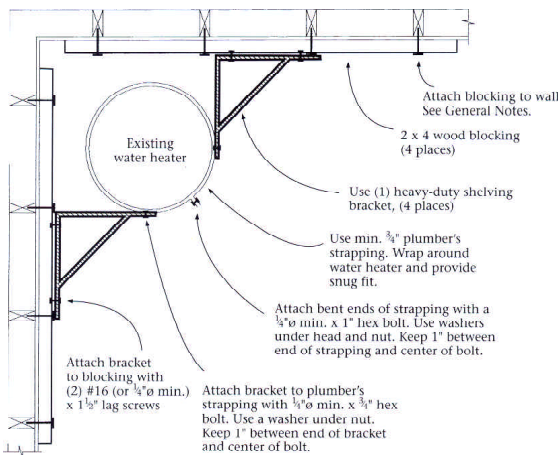
Mitigation Measure

To prevent the water heater from moving or tipping over, you need to secure it. Wrap steel plumber's tape around the entire heater at least twice. Then secure the tape to two different wall studs with 2" or longer lag screws. For added security, place blocking between the heater and the wall. This blocking could be a plywood "shelf" cut to fit the water heater's circular shape or a 2x4 or similar board behind the heater.



You should connect existing concrete or grouted masonry walls with concrete anchor bolts. There are many types, including wedge, expansion, sleeve, and epoxy. To take advantage of the full capacity of concrete anchors, space them at least 12 times the diameter of the bolt, with a minimum edge distance of 6 times the diameter. The minimum embedment length is typically 8 bolt diameters. The bolt will have a greatly reduced capacity if it is too close to an edge or an adjacent bolt or if it has insufficient embedment into the concrete. When drilling holes into concrete or masonry walls, avoid cutting any reinforcing steel (rebar) or electrical conduit by using a magnetic device to locate the steel or conduit.

The most common fasteners are wedge anchor bolts, where part of the shank expands to press against the sides of the hole as the nut is tightened. For anchorage to reinforced concrete walls, expansion anchors are the most common and easiest to install. Typical sizes for wall anchorage of non-structural items might be a $\frac{1}{2}$ " diameter A307 bolt with 4" minimum embedment, 5" edge distance, and 6" spacing. Use galvanized or preferably stainless steel bolts and other hardware where they will not be exposed to moisture, weathering or corrosion-resistant chains, eyebolts, quick-release safety hooks for gas cylinders, or other items stored outside or in a damp location.



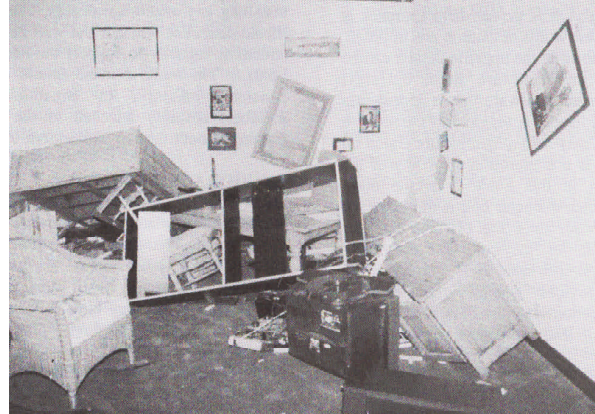
Sleeve anchors may be best for frequently moved items. Sleeve anchors consist of a threaded sleeve installed directly into the concrete, flush with the concrete surface, and a bolt that is screwed into the sleeve. When the bolt is removed, the sleeve is left flush with the wall or floor and without the bolt protruding. Epoxy anchors are inserted into slightly oversized holes with epoxy or polyester resin to hold the bolt in place.



Earthquake - 308

Secure your light home contents

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

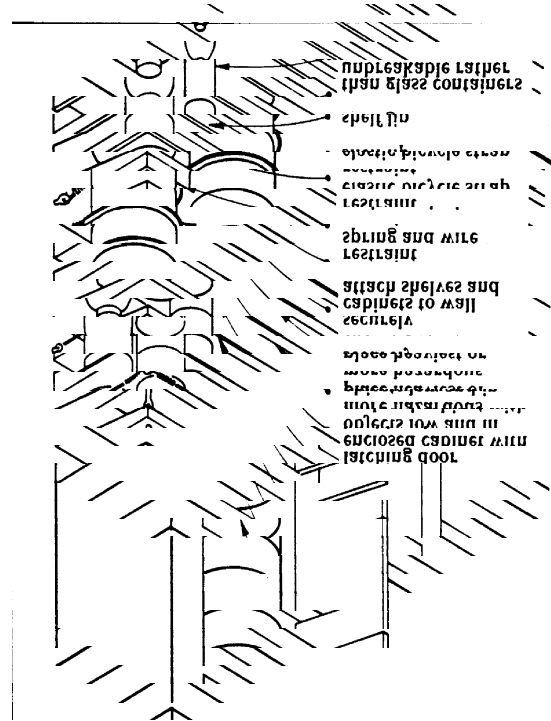


During an earthquake, falling objects could hit you and your family and cause serious injury. The strong shaking of your home may also break the glass in your home's windows and doors. The doors of your cabinets may open, so your china and other precious items fall out, and unprotected items on ordinary shelves will also fall off. Mirrors and picture glass also may break when falling from the walls. When these items hit the floor, they may shatter and spread dangerous shards everywhere. Drawers containing small objects may spill their contents on the floor. In the kitchen, these items are liable to be sharp and dangerous. Light fixtures supported by suspended ceiling grids can lose their vertical support

when the suspended ceiling sways and is distorted. Often electrical wires support pendant-mounted fixtures. When the wire splices pull apart, these fixtures also fall and break. When the fixtures swing, they can strike and break other objects. The result of the breakage will be that your home is filled with dangerous debris.

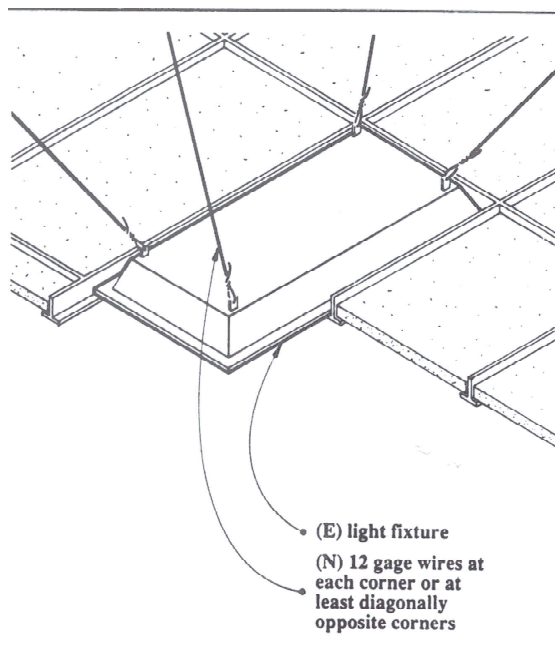
Mitigation Measure

One easy and cost-effective way to protect the glass in your home is to apply adhesive solar film to it. The film may not keep the glass from breaking, but it will prevent the glass from falling onto the floor in sharp shards. The film also will reduce heat and glare, so your home will be more comfortable and your air-conditioning and heating costs will be lowered.



You can secure cabinet doors and kitchen drawers by installing child-proof latches. You can secure light items on shelves by adding a small wooden lip or wires and springs to create an elastic lip. Another way is to use an elastic strap restraint or bungee cord around individual items. Loose shelves should be secured to their wall or shelf brackets. Wooden shelves that rest on wall-mounted brackets may be secured to the brackets with 1/2-inch-long screws. For

light and nonessential items on shelves or countertops, a 1- to 2-inch lip secured to the edge of the counter or shelf may be adequate to keep miscellaneous items from falling off. In this case, individual items do not need to be anchored.



To prevent light fixtures suspended by ceiling grids from falling, you can add independent wire ties connected directly from each fixture corner (or from diagonal corners) to the floor above. For pendant-mounted light fixtures, you can install safety wires to prevent the fixtures from falling, and diagonal wires to prevent them from swaying.

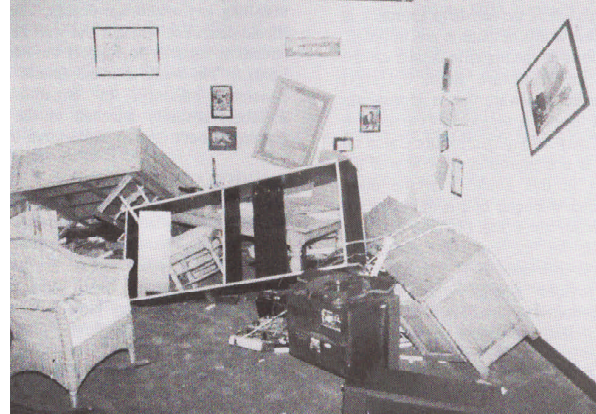
The diagram at left illustrates some of these measures.



Earthquake - 309

Secure your furniture

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard



During an earthquake, large pieces of furniture such as tall bookcases and file cabinets can fall on you or members of your family. Toppled furniture can also block exits and prevent you from escaping. Anchoring furniture so that it remains upright not only helps prevent injuries but also helps protect both the furniture and its contents.

Mitigation Opportunity

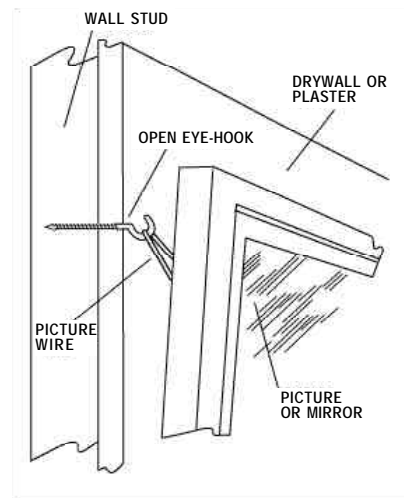
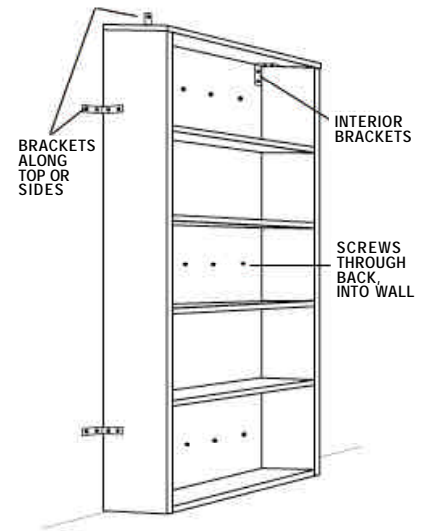
Many furnishings can be anchored, braced, or tethered to an adjacent wall to provide stability in an earthquake. First, locate the structural studs to see that they are near the items you want

anchored. If you have many items to anchor to a stud wall, it may be best to install a mounting strip so you avoid having to relocate items so they will line up with studs. A mounting strip is a horizontal piece of wood mounted to the wall and anchored to each stud. It may be constructed of structural-grade wood 2x4 or 2x6 or a continuous steel channel or angle. The mounting strip should be located at or near the top of the items you want to anchor.

You can anchor large pieces of furniture in several ways. Either bolt directly through the back of the furniture into the wall studs or use steel angle brackets. Do not use Gypsum board and most other interior wall coverings, which pull away easily from a wall. A toggle bolt or nail will also pull out during an earthquake and leave a hole in the wall. If essential contents are to be secured, the shelf or mounting surface should be secured prior to anchoring.

Attach a steel angle to wood studs using a minimum 1/4-inch-diameter by 3-inch lag bolt. Embed the bolt at least two inches into the wood stud. Attach steel angle to metal studs using #12 sheet-metal screws long enough to penetrate the flange material. Use two screws per connection, located 3 inches apart vertically.

For mounting strips, use #14 flat-head wood screws with countersunk heads, with at least 2 inches embedded into the wood stud behind the wall covering. Locate screws along the centerline of the 2x4 or 2x6, and anchor the strip to each stud with a maximum spacing of 24 inches on center. For attachments to the mounting strip, do not screw or bolt anything within 1 inch of each edge of a wood member.



Notes:



Earthquake - 310

Improve the securing of your wall sheathing

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



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Potential Hazard

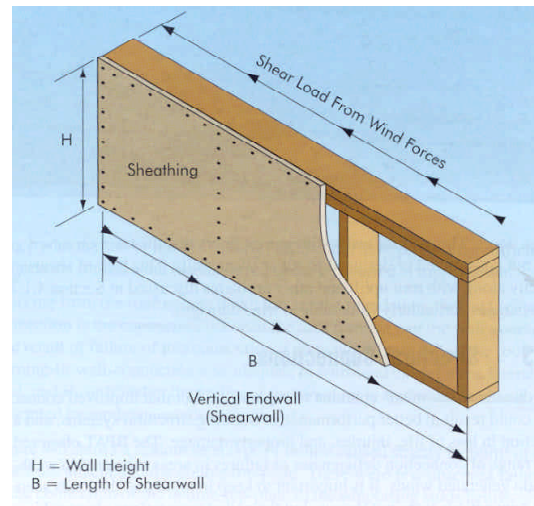
During an earthquake, building structures are distorted as they bend from side to side in response to the earthquake forces. For example, the top of a tall apartment building may lean



over a few feet in each direction. Building exterior walls are subject to horizontal forces. The building's shear walls absorb some of the loads imposed upon the building as a result of these distortions and transfer those loads to other members. If the shear wall cannot take the load, the wall may collapse. If not properly fastened to the structure of the building, the walls, interior and exterior, walls can fall down. Some homes do not have shear walls, which are typically sandwiched

Mitigation Measure

Notes:



Unit 3: Recognize the Risks and Mitigation Measures

Notes	Earthquake Exercise Sheet
Assess Earthquake Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Earthquake Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	

Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

Earthquake Risk Pictures

(See following 8 pages)

Earthquake Risk No. 1



Earthquake Risk No. 2



Earthquake Risk No. 3



Earthquake Risk No. 4



Earthquake Risk No. 5



Earthquake Risk No. 6



Earthquake Risk No. 7



Earthquake Risk No. 8



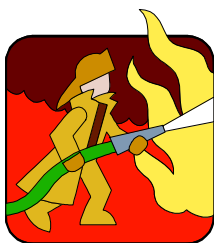
Unit 3: Recognize the Risks and Mitigation Measures

	Earthquake Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Earthquake Answer Sheet	
Picture Number	Action Checklist Number
1	301, 306, 308, 309
2	301, 303
3	(None really)
4	302
5	303, 308, 309
6	302, 309
7	301, 306, 308
8	309

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Wildfire (See following 10 pages)



Fire - 401

Create a firebreak around your property

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



The risk of fire destroying homes and property increases in areas where wildlands and developed areas meet. More people are making their homes in woodland settings—in forests, rural areas or remote mountain sites. In areas where wildfires have occurred naturally for centuries, homes and gardens now add fuel that can accelerate the spread of fire. When wildfires occur today in these areas, limited resources often force fire fighters to choose between attacking the fire or defending a particular home. Manufactured homes, where death rates are twice as high as for other housing types, are of particular concern. Do not rely on luck—plan ahead.

Potential Hazard



Wildfires destroy hundreds of homes and acres of land every year. When the wind is blowing, a fire can spread very rapidly. If it is blowing strongly in the direction of your home, the fire could be fatal to you and your family. Having underbrush, dead leaves, or vegetation on the outside walls of your home increases your risk of losing your home. Recognizing these hazards is the first step toward making sure that they do not increase your risk of losing your life or home.

Mitigation Measure

Using fire-safe landscaping is an effective way to create an area of defensible space between your home and flammable

vegetation. Interrupting a fire's potential path is a first step to protecting your property and the area near your home.

Be sure to keep potential combustibles such as stacked firewood away from your home. If you live in a high-risk wildfire area, this small inconvenience is well worth the effort when compared to the increased safety it provides to your life and property.



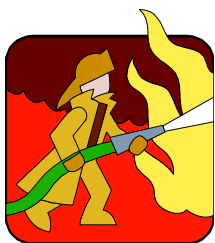
Experts say that if possible, you should keep a defensible space of at least 30' around your home cleared of vegetation. Hillsides are especially dangerous because they are very likely to catch gusts of wind. As a result, experts recommend that you clear a perimeter up to 100' for very steep hillsides. Also, remove vines from the sides of your home. Bare walls may not seem as pretty, but it is best to remove possible fuel from growing on your home. Keep your lawn trimmed and leaves raked, and keep your roof and rain-gutters free from debris like dead limbs and leaves.

Maintain a well-pruned and watered landscape to provide additional protection against fire. Shrubs should be pruned regularly. Remove small trees and plants growing under larger trees because they allow ground fires to jump into tree crowns. Space trees 30' apart, and prune them to a height of 8' to 10'. Pruning cuts should be clean and smooth; avoid flush cuts and stubs. Young, vigorous trees can withstand more severe pruning than older, weaker trees. Remove dead and diseased branches. To avoid stress to the tree, remove no more than one-third of its live foliage at one time.

The best time of the year to clean up the forest floor around your home is late fall after the leaves have fallen. This job does not require any special skills and should not take very long. This cleanup should be done every year. After the first cleanup of accumulated vegetation, the

job should require less time and effort. Where possible, you should promote the growth of fire-resistant plants and vegetation. Although no plant or tree is truly "fire-proof," some catch fire less readily than others.





Fire - 402

Relocate or protect your exterior fuel tanks

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Potential Hazard

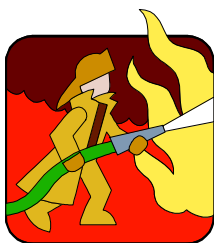


If a wildfire gets close to your home, it is very dangerous to have a large container of fuel near or attached to the outside of your house. Besides the possibility that the fuel may enlarge the fire already in progress, having a fuel tank nearby can make saving your home very difficult because no one can go near it. If a fuel tank gets hot enough to ignite, it can have the same effect as a small bomb going off.

Mitigation Measure

You should move the external fuel tank about 30 feet away from your home. Doing so may require using equipment powerful enough to

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Fire - 403

Maintain your gutters & clear roof of debris

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



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Potential Hazard

Fires start easily and burn rapidly with light fuels like dry grasses and leaves, and then they ignite the homes nestled among them. Every year, wildfires destroy hundreds of homes across the country. In areas where wildlands



and developed properties are side by side, homes and other structures can become more fuel for fires. Dry leaves and twigs in your home's gutters may become added fuel to potential fires as well as interfere with their main purpose, to carry water away from your home.

Mitigation Measure

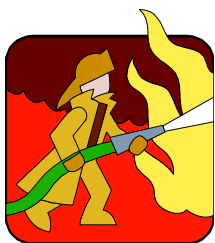
Denying fuel to a fire is one of the most successful ways of containing it and possibly saving your life and your home. If you live in a high fire hazard area, dead leaves and twigs need to be removed from your gutters and anywhere else on your roof where dead brush can accumulate. Many companies offer gutter cleaning services. The best time of the year to clean your gutters is in late autumn after the leaves have fallen. The cleanup should be done once a year. A crew of one or two people can clean your home's gutters in an hour or two.



One way to keep your roof clear of debris is to trim tree branches that overhang your home. Also, if there are dead or dying trees near or overhanging your home, you should have these trees removed.

Notes:

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Fire - 404

Cover openings with fine mesh

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



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Potential Hazard

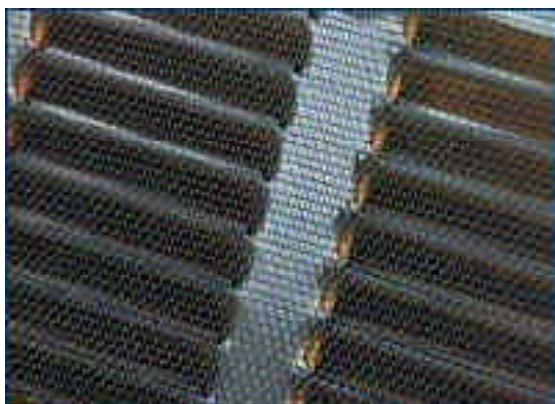


Fire needs fuel – something to burn, like grass, bushes, trees, or the homes nestled among them. Every year, wildfires destroy hundreds of homes and acres of land across the country. In areas where wildlands and developed properties are side by side, homes and other structures can become more fuel for fires. A slight breeze could carry burning cinders or sparks through any opening into your home. They can enter through even a small opening such as exterior venting, attic louvers, or the eaves. Sparks entering the house could set your house on fire.

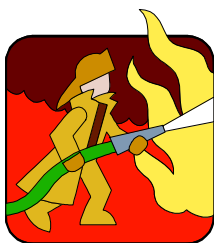
Mitigation Measure

Using a non-flammable fine wire mesh screen to cover the openings of your home will keep floating cinders or hot ash from entering and starting a fire. The reverse is also true; a fire that starts inside will be less likely to travel to the outside if openings are covered or protected by non-flammable wire mesh screens. This measure will help protect you and your family, your neighbors, and the environment.

All windows should have screens, and if you frequently leave your doors open, you should put screens on them, too. Screens are relatively easy to install, and even custom-made screens for irregular sized doors and windows are affordable.



Notes:



Fire - 405

Use fire resistant materials on your home

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Potential Hazard



When wildfires and brush fires spread to homes, it is often because burning branches, leaves, and other debris are lifted by the heated air and carried by the wind to roofs. Wood or asphalt shingles catch fire more easily than fire-resistant materials like slate, tile, and metal, which offer greater protection to your home. Although a distant wildfire is more likely to set your roof on fire than any other part of your house, it is also possible that hot cinders landing on the side of your home could set your home on fire.

Mitigation Measure

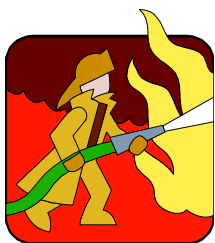
When you need to replace your roof, it is best to replace flammable roofing with fire-resistant materials such as slate, terra cotta or other types of tile, or standing-seam metal roofing. Although the fire-resistant materials are a little more expensive, you are also buying added protection against fire.

Slate and tile shingles generally are much heavier than asphalt or wood shingles. If you are considering switching to one of these heavier coverings, your roofing contractor should determine whether the framing of your home is strong enough to support them. If you live in an area where snow loads are a problem, consider switching to a modern standing-seam metal roof. Besides being fire resistant, it usually sheds snow efficiently.

If it is necessary to replace the wood siding on your house, you should use a non-flammable material like aluminum. Similarly, if you are replacing any doors and shutters, you should use aluminum or another metal. In addition, when you remodel your home, you should consider using fire resistant materials such as metal studs and fire resistant wall board.



Notes:



Fire - 406

Install Outdoor Spigots

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Potential Hazard

Whether a wildfire starts from natural causes, accidents, or carelessness, if it is near your home, it could quickly consume everything you own. If you act immediately, you may be able to bring a small fire under control and extinguish it. Having a source of water available outdoors can make a critical difference to whether your property can be saved.

Even if the fire is so far away that you cannot put it out, having an outside source of water is very advantageous. If you have enough warning, you can wet down the vegetation surrounding your home as well as your roof and siding. This action could lessen your damage from the wildfire. Also, if the wildfire is moving rapidly, wetting your home and property could protect your home long enough for the fire to pass or for firefighters to come to your assistance.

Homes that are in densely wooded areas or in areas with large amounts of underbrush are especially susceptible to wildfires.

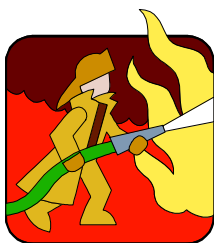
Mitigation Measure

If you live in an area at high risk from wildfires and your home does not have a spigot outdoors, you should install one. In fact, it is even better if your home has two outdoor spigots. With a spigot on both sides of your home, you can respond to a small fire emergency more quickly than if you had to use a hose attached to a spigot on the other side of your home. Having a second hose also provides you a greater capability to reach the places you want to wet down. Hoses should be equipped with nozzles in order to gain extra distance and ease in watering. Furthermore, having a nozzle makes it easier to reach the uppermost portions of your roof.



Of course, in the case of a large fire, if you are at all uncertain about whether the fire is controllable, you should evacuate the area and seek safety. If the authorities issue a general directive to evacuate an area, follow their instructions. Preserving your life and the lives of your loved ones is more important than anything else.

Notes:



Fire - 407

Install smoke & carbon monoxide detectors

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Potential Hazard



Smoke detectors are one of the most effective safety features you can install. If you have a fire, a working smoke detector can save your life and the lives of your loved ones. In fact, having a working smoke detector can double your chances of survival. A detector is the single most important means of preventing home fire fatalities by providing an early warning signal so you and your family can escape.



Mitigation Measure

Smoke detectors have saved thousands of lives, but homeowners do not always use them as effectively as they should. First, twelve percent of homes without detectors account for more than half of the fires. Second, it is estimated that one-third of the detectors in place are useless because they have a worn out battery; and third, smoke detectors in many homes are poorly located or there are not enough of them to protect the occupants properly.

Many hardware, home supply, or general merchandise stores carry smoke detectors. If you are unsure where to buy one in your community, call your local fire department (on a non-emergency telephone number) for suggestions.



The primary job of your smoke detector is to alert you to fires while you are asleep. Thus, your smoke detector should be located outside bedrooms or sleeping areas. In a multi-story home, a fire on a floor level without a smoke detector can grow to dangerous size before enough smoke rises in a stairway to set off a detector on an upper floor.

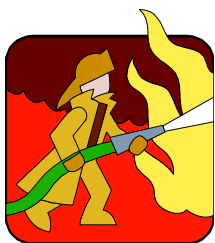


There are a few places where a smoke detector should not be placed. These include kitchens and garages because cooking fumes and car exhaust are likely to set them off, and unheated attics and crawl spaces because they can get too cold or hot for the electronics to work properly. Fires in these areas are generally detected by the other smoke detectors in enough time for you to escape safely. If you want a detector in these spaces, use a heat detector.

Remember that smoke detectors are the main safety devices in any home protection plan.

Smoke detectors are easy to install. In most cases, all you will need is a screw driver. Many brands are self-adhering and automatically stick to the wall or ceiling where they are placed. However, be sure to follow the directions from the manufacturer because each brand is different. If you are uncomfortable standing on a ladder, ask a relative or friend for help. Some fire departments will install a smoke detector in your home for you. Because smoke and many deadly gases rise, installing your smoke detectors at the proper level will provide you with the earliest warning possible.





Fire - 408

Provide fire extinguishers in your home

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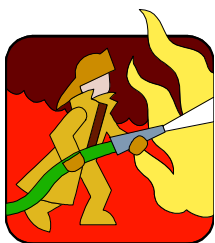


Potential Hazard

If you detect a small fire near your home, you may not have time to wait for the fire department to put out the fire. If you are lucky enough to catch a fire still in its formative stages, you may be able to put it out by yourself. However, the chance that a fire might be within reach of your garden hose is probably slim. The kitchen stove or space heaters may catch fire, or a cigarette or cigar could start a fire in any room in your house or outside your home.

Mitigation Measure

Having a wall mounted fire extinguisher will make it easier for you to put out a fire quickly. Fire extinguishers come in different sizes. Almost anyone can handle the smaller ones. Most adults can operate larger extinguishers. Be sure you and everyone in your family understands how to operate the extinguisher. Before you face a fire emergency, you should practice holding and aiming the extinguisher. Then, in case of a fire, you will know exactly what to do and be able to do it. While you are practicing, be sure you do not pull the trigger on the extinguisher and set it off. Also, have the pressure of the extinguisher checked to ensure the device continues to remain effective. Your local fire department can perform this service for you.



Fire - 409

Install a spark arrester in your chimney

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Potential Hazard

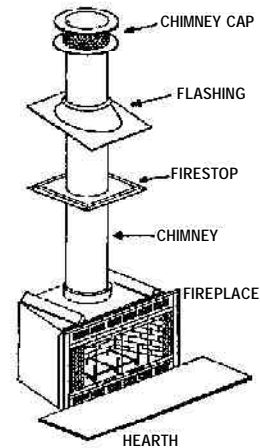
We've all seen sparks or red-hot ash fly out of chimneys at night. That hot ash or spark rising out of your chimney could land in dry foliage. If it is still hot, there is a chance that this spark could start a major fire that could endanger your home and the surrounding community.



A fire is even more likely to start from a spark landing in a tree than on the ground for several reasons. Because the spark takes less time to go into a tree than to fall to the ground, it is more likely to be hot enough to catch fire. Also, a limb is exposed to breezes which can fan any smoldering sparks into a fire.

Mitigation Measure

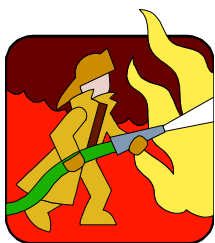
Having either a chimney cap or a spark with wire mesh arrester on your chimney can keep hot particles from drifting out the top of your chimney and starting a fire. Although chimney caps keep rain from falling down the chimney, they do not keep sparks from escaping. Therefore, before you install a chimney cap, be sure it has a fine wire mesh between the cap and the chimney. Any chimney cleaning service can install a spark arrester, whether your chimney has a cap or not. A spark arrester is usually spring-loaded and fits into the top of the chimney. Many come with screws or bolts so you can anchor them to the inside wall of the chimney. A spark arrester should be inspected every five years to make sure it has not rusted.



Keep tree branches and limbs about 15' to 20' away from your chimney stack. It is best to hire a tree professional who knows how to trim the tree so that it does not become unbalanced in the process and create another hazard.



Notes:



Fire - 410

Keep your chimney clean

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



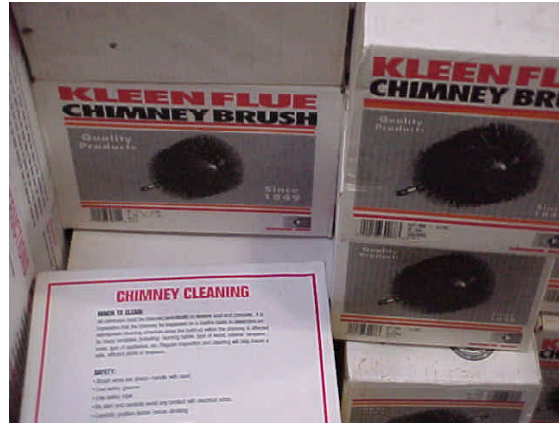
The risk of fire destroying homes and property increases in areas where wildlands and developed areas meet. More people are making their homes in woodland settings—in forests, rural areas or remote mountain sites. In areas where wildfires have occurred naturally for centuries, homes and gardens now add fuel that can accelerate the spread of fire. When wildfires occur today in these areas, limited resources often force fire fighters to choose between attacking the fire or defending a particular home. Manufactured homes, where death rates are twice as high as for other housing types, are of particular concern. Do not rely on luck—plan ahead.



Potential Hazard

Thick creosote build-up inside a chimney can ignite into an intense blaze. Chimney fires can cause flames or dense smoke to shoot from the top of the chimney. If a flaming spark or red-hot ash from your chimney lands on the ground or in a tree, it can start a fire there. Your chimney can turn into a flaming pillar that sets your home on fire. It might even burn explosively and set nearby property and homes on fire.

The experts say a regularly used chimney should be cleaned once a year. “Regular use” means as little as one cord of wood a year. A chimney needs regular cleaning because the creosote from the fires builds up on the inside of the chimney, and that area eventually becomes lacquered. This lacquer, when it is hot enough to flame, can be difficult to put out, especially when the fire is located in a hard to reach area.



Cleaning your chimney every year may save you the expense of hiring a professional chimney sweep. If your chimney has never been cleaned or has not been cleaned for a long time, it may require a professional cleaning.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Wildfire Exercise Sheet
Assess Fire Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Wildfire Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	

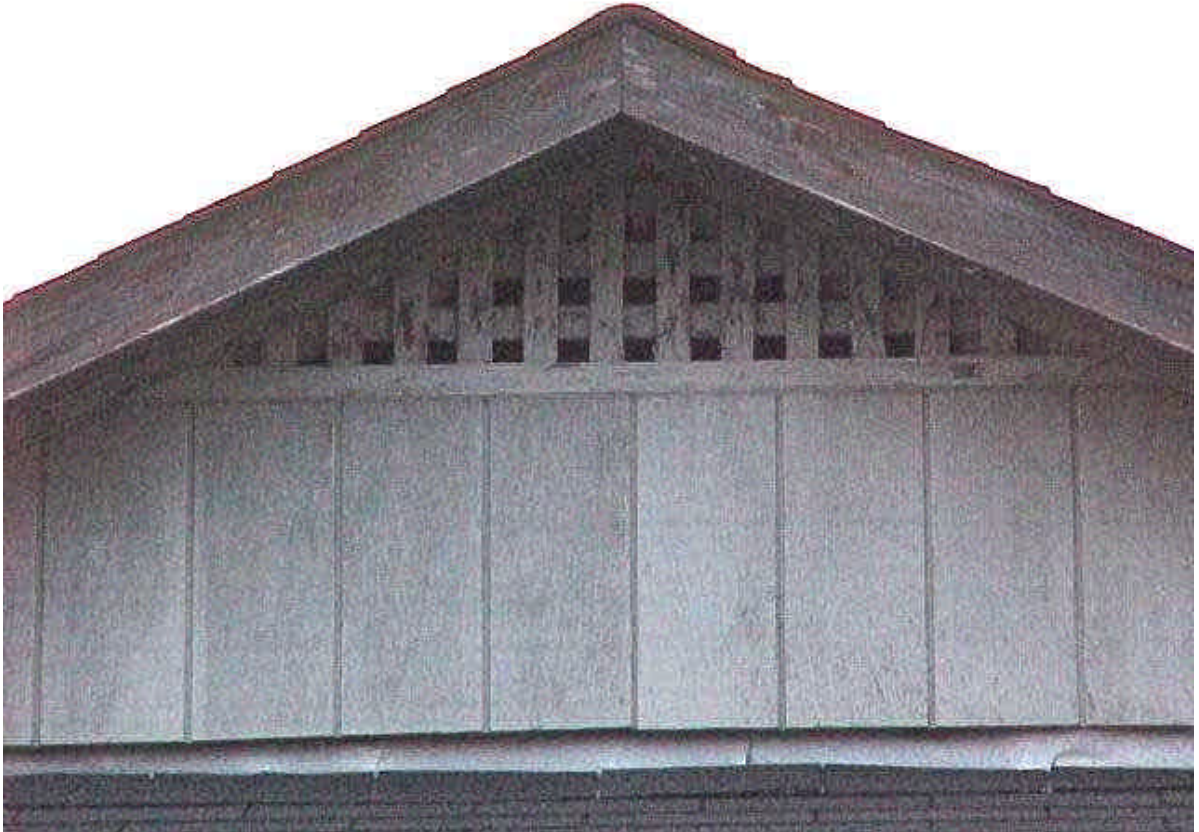
Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

Wildfire Risk Pictures

(See following 8 pages)

Wildfire Risk No. 1



Wildfire Risk No. 2



Wildfire Risk No. 3



Wildfire Risk No. 4



Wildfire Risk No. 5



Wildfire Risk No. 6



Wildfire Risk No. 7



Wildfire Risk No. 8



Unit 3: Recognize the Risks and Mitigation Measures

	Wildfire Exercise Sheet – Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Wildfire Answer Sheet	
Picture Number	Action Checklist Number
1	403, 404, 405
2	401, 403, 404, 405, 406
3	401, 403, 404, 405, 406, 409, 410
4	401, 402
5	401, 403, 405, 409, 410
6	407, 408, 410
7	401, 402, 405, 406, 408
8	401, 403, 404, 405, 406

Choose Appropriate Mitigation Measures

Final Exercise

The following pictures show parts of properties which may or may not have potential risks from a disaster. First, decide what kind of risk you want to focus on: flood, wind, earthquake, or fire. Look carefully for every potential risk, then decide what mitigation measures are appropriate. Use the Action Checklist a reminder of what to look for. Use the following sheet to record your answers. Write the number of the picture that has the risk beside the mitigation measure.

For example, look at the picture below. What potential risks do you see from: Flood? Wind? Earthquake? Wildfire?



Unit 3: Recognize the Risks and Mitigation Measures

Final Review Answer Sheet

Directions: Put the picture number beside the number of the mitigation measure you recommend.

FLOOD

Mitigation Measure	Picture Number(s)
101	
102	
103	
104	
105	
106	
107	
108	
109	
110	

WIND

Mitigation Measure	Picture Number(s)
201	
202	
203	
204	
205	
206	
207	
208	
209	
210	

EARTHQUAKE

Mitigation Measure	Picture Number(s)
301	
302	
303	
304	
305	
306	
307	
308	
309	
310	

WILDFIRE

Mitigation Measure	Picture Number(s)
401	
402	
403	
404	
405	
406	
407	
408	
409	
410	

1





3





5





7









Unit 3: Recognize the Risks and Mitigation Measures

FLOOD

Mitigation Measure	Picture Number(s)
101	9
102	1, 2, 3, 4, 5, 8, 9
103	1, 4, 8
104	3, 4, 8, 9, 10
105	1, 2, 3, 4, 5, 8
106	2, 5, 7, 9
107	1, 2, 3, 4, 5, 7, 8
108	1, 2, 3, 5, 8
109	1, 2, 5, 9, 10
110	2, 10

WIND

Mitigation Measure	Picture Number(s)
201	1, 2, 3, 4, 5
202	2, 3, 4, 8
203	1, 2, 5, 7
204	5, 7
205	5, 7
206	1, 2, 3, 4, 5, 7, 8
207	2, 5, 7
208	2, 3, 4, 5, 6, 8
209	1, 2, 4, 5, 6, 10
210	5, 7

EARTHQUAKE

Mitigation Measure	Picture Number(s)
301	1, 2, 3, 4, 8, 9
302	2, 3, 4, 7, 8
303	1, 2, 5
304	5
305	5
306	3, 4, 8, 9
307	10
308	6, 10
309	9
310	2, 5

WILDFIRE

Mitigation Measure	Picture Number(s)
401	1, 2, 3, 4, 5, 8
402	4, 8, 9
403	1, 2, 4, 5, 8
404	1, 2, 4, 5, 6, 7
405	1, 2, 3, 4, 5, 7, 8
406	1, 2, 3, 4, 5, 8
407	6, 7
408	6, 7, 8, 10
409	5
410	5

Unit 3: Recognize the Risks and Mitigation Measures

Verify Understanding

Discuss participants' recommendations and reasons.

Ask for questions.